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THE AMERICAN GAS LIGHT JOURNAL

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[OFFICIAL NOTICE.]

Twenty-second Annual Meeting, Western Gas Association.

WESTERN GAS ASSOCIATION,
OFFICE OF THE SECRETARY,
NEW ALBANY, IND., May 2, 1899.

To the Members of the Western Gas Association:

The twenty-second annual meeting of the Western Gas Association will be held at the Hotel Pfister, Milwaukee, Wis., June 14, 15 and 16, 1899, and will be called to order by the President, Mr. George Treadway Thompson.

The rates at the Hotel Pfister will be from $1.50 to $3 per day on the European plan, and from $3 to $5 per day on the American plan. More satisfactory arrangements can be obtained by securing rooms in advance of the meeting.

Arrangements are being made with the various Passenger Associations to secure the usual reduction in fare.

Queries for the Question Box should be mailed to the Secretary in advance of the meeting.

An invitation is extended to all members of kindred Associations to be present at our meeting and to participate in the discussions.

The undersigned will be pleased to mail blank applications to any who may desire to join the Association, and to reply to all communications concerning the meeting.

JAMES W. DUNBAR,
Secretary.

[OFFICIAL NOTICE.]

May Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, May 4, 1899.

The May meeting of the Society of Gas Lighting will be held in "The Arena," No. 39 West 31st street, New York city, at 3 P.M., the 11th inst.

FRED. S. BENSON,
Secretary.

[OFFICIAL NOTICE.]

Wrinkle Department, Western Gas Association.

WESTERN GAS ASSOCIATION,
OFFICE OF THE SECRETARY,
NEW ALBANY, IND., January 16, 1899.

To the Members of the Western Gas Association:

Mr. E. H. Jenkins, Editor of the Wrinkle Department, desires it known that those who have contributions to offer for publication in this valuable division of the Association's proceedings, should forward the same at as early a date as possible. Let no member fail to mail Mr. Jenkins a description of any device that saves labor or insures through its use better service in the production or distribution of gas.

Address all communications to Mr. E. H. Jenkins, Engineer Buffalo City Gas Company, Buffalo, N. Y.

J. W. DUNBAR,
Secretary.

BRIEFLY TOLD.

A FATUOUS WAR OF RATES.—It is rather queer to know that corporations will expend considerable sums of money to prevent legislatures from interfering with their businesses in certain ways, but it is queerer still to see the same corporations, on the immediate adjournment of a legislature, take steps against themselves very much in advance of anything proposed by the lawmakers. Such, however, is the current picture in the gas affairs of the Manhattan section of New York city. The "expired" Legislature of New York had many gas measures before it, most of which had to do with the price that might be charged; and in the list the rate was variously named at 90 cents per 1,000 as a maximum and 75 cents as the minimum. For New York borough even a municipal gas works was proposed. The suggested measures all failed, from one cause or another, of passage. The Legislature adjourned, April 28th. May 1st the gentlemen in charge of the Consolidated Gas Company said to their customers that, "until further notice," the selling rate would be 65 cents per 1,000 cubic feet; at about the same time, and not far from the same place, the proprietors of the New York Mutual Gas Light Company sang, "Me, too." The New Amsterdammers followed their lead with a 50-cent per 1,000 trump, and the Sage man of the Standard Company later on remarked that his Company's consumers need not transfer their allegiance to others, because of any variance in the rates—no banners flaring the cut from the legal rate were flaunted by Mr. Sage's Company. And such is the situation in the gas business in New York borough to-day. Regrettable it is beyond a doubt, for the contention is suicidal; and the responsible parties behind the New Amsterdam Company, be they gas men, or electricians, or hybrids, are those who will pay for it all in the long run. The affair in its present illumination causes one to think of the time when the struggle for control of the gas situation in Brooklyn was on, and those who remember the termination thereof know that value there won in the long run. The contest here to-day looks a fair exemplification of *paritur pax bello;* but, as a rule, the peace that is produced by war usually ends to the cost of the weaker of the combatants, and our electric friends should remember that the race is not always to the swift. Apart from generalization, however, the present miserable contest is to be deprecated, especially on the broad ground that financiers' estimates of what it costs to make and sell gas are now accepted as gospel by the ordinary investor. It is not so long ago that the engineer said to his capitalist employer, I can earn so much money on such an amount of capital at such a price for gas; now the capitalist says, I have issued so much stock, and it is your duty to earn such a return upon it. Talk about burning the candle at both ends; or of having your cake and eating it! Either would be easy in comparison with the task laid upon the engineer by his banking salary master. Extraneous much of the above may seem to the reader, so far as it all applies to the "cuts" in gas rates in this section since May's opening, but the logic of some of it is that the New Amsterdam and others of the marauding gas and electric concerns, with much franchise right and less property, should remember their instability. All round, though, the war is to be deprecated; but whether the battle is a real issue or a sham, the fact in our belief remains that the ones who will dictate its settlement are those who will control the Consolidated and the Mutual Companies. Some wails are heard from out of-town districts as to the harm that is being caused by the 50-cent New York rate to the industry in general; but as the wailings largely come from territories where like things have been done in the past, they may fairly be disregarded. In fact, take it all in all, New York has had a pretty good record, so far as maintaining gas rates is concerned.

NOTES.—The entire force of the Richmond (Va.) City Councils has taken up more than four weeks in considering whether a new gasholder shall be built at the West End station. It is conceded that the holder is a necessity, and its cost is put at $15,000. Another illustration of the virtue and value of municipal control.——Messrs. Edward C. Jones & Co., of New York, have acquired the properties of the Bethlehem (Pa.) Gas Light Company.——At the annual meeting of the Hempstead (L. I.) Gas Light Company the following officers were elected: Directors, John E. Davidson, Jas. L. Jenson, R. Ingraham, T. A. Carman, G. D. Smith, Valentine Snedeker and C. F. Gittens; President, J. E. Davidson; Vice-President, James L. Jenson; Secretary and Treasurer, Chas. F. Gittens.——The annual meeting of the United Gas Improvement Company was held in its new building, Broad and Arch streets. President Dolan's report of the Company's operations for the year showed plainly that the gas business flourishes. No change was made in the executive management.

Moving Large Mains in Service.[1]

The abolition of grade crossings on Pennsylvania avenue in the heart of Philadelphia has made it necessary to lower the tracks of the Philadelphia & Reading Railway for nearly 2 miles, and there has just been constructed for them at great expense a subway involving 6,330 feet of open cut and 2,711 feet of tunnel work. The subway is crossed by 32 water mains and many gas pipes. The largest water mains are 48 inches in diameter and the largest gas mains are 30 inches in diameter. All of them had to be raised or lowered from their original position, and various methods were adopted for handling them.

Two general methods were adopted when the mains crossing the line of the subway required to be depressed. In most cases where it was required that the flow should be maintained, the only main was left undisturbed until a trench had been excavated sufficiently to one side to prevent accident. A new main was laid in the trench and completed except at the ends, where special castings were used to make the connections. When all was in readiness the old main was cut and the connections made. The old main was then removed in the course of the excavation. In the case of the 48-inch mains the work in making the connections usually occupied about 24 hours.

When it was practicable to abandon the old main temporarily, it was cut and the new line made on the old alignment.

When it was necessary to cross the subway below the level of the tracks, usually requiring a lowering of from 25 to 30 feet, the mains have the appearance of an inverted siphon, the connections between the high and low levels usually being made at an angle of about 45°, rounded off with special curves of about 15 feet radius.

The maximum distance the main had to be raised to cross over the top of the subway did not exceed 4 feet. In such a case the main was usually supported on blocking and trestles and carefully wedged up as the excavation was made. After the side walls had been built the pipe trench was opened for a sufficient distance each side of the subway and the main raised to the necessary height by screwing up suspension loops supporting it at every joint. This adjustment was made in a total length of 140 feet in the worst case. One man was stationed at each bearing of the suspension rods, or two men for 48 inch mains, and all the nuts were simultaneously turned 1 revolution at a signal. Then the men moved to an adjacent section and repeated the operation, and so on until the whole main had been raised, the end nuts being turned a little less than the others. Then commencing a short distance from one end they worked back to near the other end in the same manner, and thus continued going back and forth with a slightly diminished length of main each time until the main had been lifted to the required height at the center. By this method a 48-inch main was raised 3 feet by 50 men in 15 hours.

The operation of screwing up a 48-inch main at 24th street is illustrated in Figure 1, where two mains are shown crossing Pennsylvania avenue. One of them is still supported on the low trestles, which carried both of them across the excavation. A taller trestle was afterward erected and carried a pair of 18 x 24-inch lifting beams parallel to and on each side of the nearest main and above its final position. Pairs of 10 x 10 inch cross pieces were laid on top of these beams and between each pair at each end was a vertical 1¼-inch screw rod, by which the pipe was suspended, as shown in Figure 2. These rods were about 10 to 12 feet long, with a screw cut 3 inches on the lower end, and on all but about 3 feet of the rest of the rod. There is a nut on each end, the upper one bearing on an 8 x 8-inch cast iron saddle plate across the tops of the beams and the lower one taking bearing on the under side of a 4 x 8 x 1-inch steel plate, which supports the shoulders of a pair of semi-circular cradle pieces made as shown in Figure 2. The bearing faces of the upper nuts and plates were smoothed and oiled and they were turned with 3-foot steel wrenches.

In order not to obstruct the subway construction, trestle falsework was omitted from about 38 feet of these pipes, as shown at the left of Figure 1.

While thus unsupported there was a wreck on the railroad track on the bank above the skew back masonry. The tender of an ordinary freight locomotive was derailed and fell down about 6 feet on top of this pair of pipes, and remained lying there, wholly supported by them for about three hours. This accident did not break the pipes nor cause any considerable leakage under the water pressure of about 27 pounds then carried, and it did not cause any serious displacement nor distortion of alignment. Some leakage always occurred at the joints of the large pipes when they were raised or lowered, but it was usually negligible until the operation was completed, when it was remedied by

1. *Engineering Record.*

recalking. In some cases the mains have been carried across and beneath the subway in rock tunnels driven before the subway was excavated. Here, of course, the new pipe was laid in the tunnel and the corresponding length of old pipe was removed. Some of the mains were suspended from the highway bridges crossing the subway, and there the suspended portions are at a higher level than the adjacent

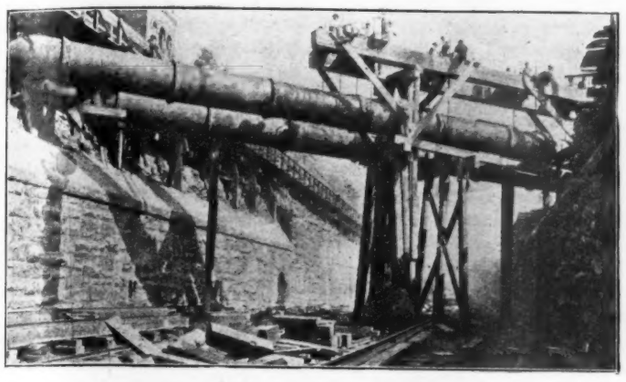


Fig. 1.—Raising a 48-Inch Water Main

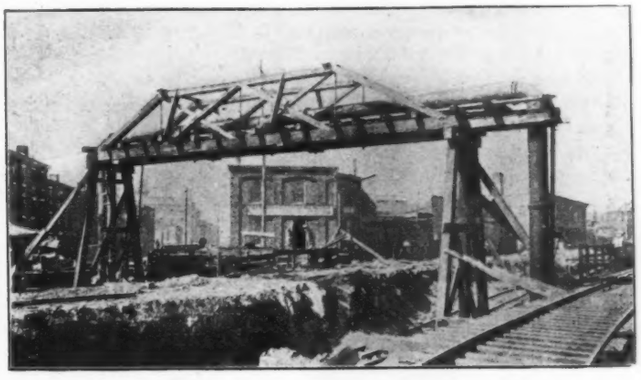


Fig. 5—A Temporary Gas Main.

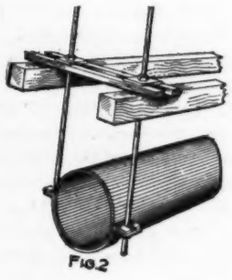


Fig. 2

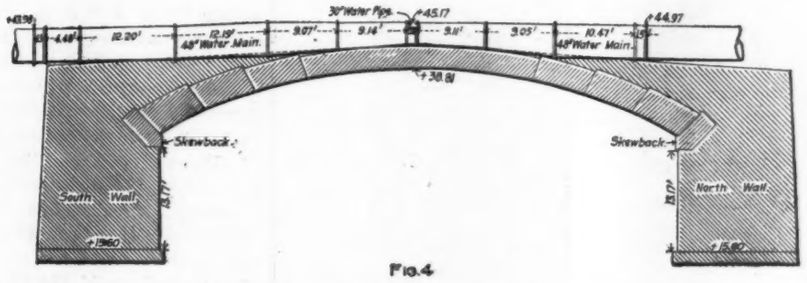


Fig. 4

Figs. 2 and 4.—Diagrams of Pipe Sling and Completed Crossing at 24th Street.

reversed curves it would have no tendency to deflect after it was thoroughly settled in place, but would, on the contrary, be able to sustain any load likely to be applied to it. Therefore it was thought entirely proper to cut away a portion of the arch.

At 24th street an entirely different method was adopted under similar circumstances, where there was insufficient room to carry the 48 inch sections in the trenches and are connected to them by special castings on easy curves.

The Fairmount avenue main is 48 inches in diameter, and just before it crosses the tunnel it divides two 36-inch parallel branches which rise about 4 feet with a reversed curve and after crossing the arch descend similarly and again unite into a single 48-inch pipe at the grade. As there was not sufficient room for even the 36-inch pipes on top of the arch, grooves about 18 inches in maximum depth were cut for them in the brickwork across the crown, which had a minimum original thickness of 3 feet. This brought the pipe to the necessary depth below the

Fig. 3.—Pipes Over Arch.

surface, as shown in Fig. 3. It is believed that the straight pipe itself would alone have been nearly self-sustaining without support between the subway walls, and that with the considerable arch action of the two main between the top of the tunnel arch and the surface of the street. About 18½ feet of the old main was removed on each side of the center line of the tunnel and replaced by two special sections reducing the diameter continuously to 30 inches and made so that the upper side is nearly horizontal. This gave all the slope of the reduction to the bottom of the pipe and brought it tangent to the arch near the crown. The two small ends of the reduced section were united by a double bell piece 30 inches in inside diameter and 16 inches long, into which both were calked, as shown in Fig. 4. The inside of the reducer pipe was bored smooth and coated with hot coal tar to diminish friction and prevent obstructions lodging there. Piezometer tests showed that with a velocity of 4.5 feet per second at the throat the discharge was 14,300,000 gallons in 24 hours, and the loss of head 0.018 pounds, and with a velocity of 16.38 feet, the discharge was 51,900,000 gallons, and loss of head 0.233 pounds.

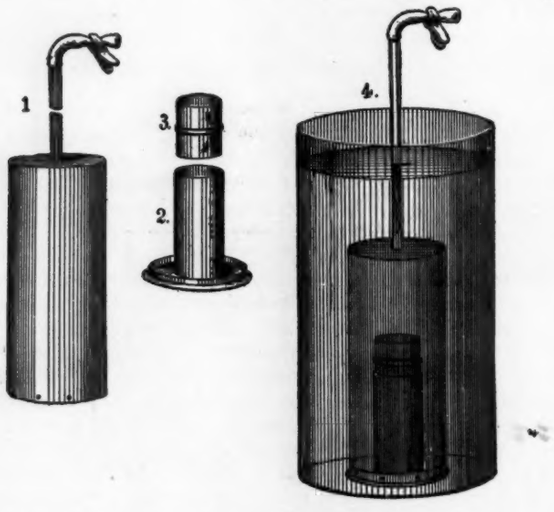
Except as noted, the changes in the water mains were made by ordinary methods, and some of the gas main crossings were similarly handled. At 22d street a 20-inch gas main crosses over the tunnel, and to avoid obstructing the steam shovel which was used for excavation here, the main was, at the commencement of operations, elevated about 20 feet with a couple of 90° offsets, and a section 40 feet long was carried across overhead on a temporary Howe truss combination bridge of about 33 feet clear span, as shown in Fig. 5. After the completion of the tunnel at this point the main was lowered to its final position resting on top of its masonry.

The subway work has been done by the Department of Public Works, Bureau of Surveys, Mr. Geo. S. Webster, M. Am. Soc. C.E., Chief Engineer; Mr. Samuel Tobias Wagner, M. Am. Soc. C.E., First Assistant Engineer. The changes in the water pipes have all been planned and carried on under the direction of the Bureau of Water, Mr. A. J. Fuller, Assistant Engineer, assisted by Mr. John Montgomery, Water Purveyor of the Fourth District. The gas mains were moved by the United Gas Improvement Company.

A Cheap Method of Making a Simple Calorimeter.

Mr. Frank F. Bradley, writing in the *Scientific American*, says that a calorimeter for determining approximately the heating value of any combustible solid, as coal, may be made at a cost of one dollar or less. The bomb calorimeters for making absolute calculations cost several hundred dollars; but where results do not need to be absolute, and expensive instruments are not to be had, the instrument described below may be used, and with comparatively accurate results.

A sheet of heavy copper is made into a cylinder 7 inches high and 3 inches in diameter, as in Fig. 1. Over one end of the cylinder is soldered a copper cap, from which runs a copper tube perhaps ¼ of an inch in internal diameter. Let the tube be 12 inches high and have a stopcock at its extremity, or, perhaps, have a few inches of flexible rubber tubing attached which shall have a pinchcock. To the other end of the cylinder fit a movable cover with an inside, tightly fitting flange, like the cover of any small pail. Within this cover solder a copper cylinder 3 inches high and 1½ inches in diameter, as in Fig. 2. Next make



a cup, as in Fig. 3, which is 1½ inches high and a trifle less than that in diameter, placing around it, on its middle line, a flange, so that it may be placed partly in the cylinder of Fig. 2. Obtain a glass jar 6 inches in diameter and 1 foot high, or with about these measurements. The completed calorimeter is shown in Fig. 4. Several holes are punched near the bottom of the outside cylinder to allow the egress of the gases and the ingress of the water from the glass jar.

The British thermal unit is the amount of heat necessary to raise the temperature of 1 pound of water from 39° F. to 40° F. Hence, if 3 grammes of fuel is burned in the cup and 2,901 cubic centimeters of water is present, the heating value will be as many calories as the temperature of the water is raised in degrees.

A mixture of 3 parts of potassium chlorate and 1 part of potassium nitrate is mixed with the fuel to supply oxygen for the combustion; and, as the nitrate absorbs heat and the chlorate gives off heat upon burning, when mixed as above the effect of each is neutralized. After the combustion has taken place the stopcock is opened, so that the water may fill the apparatus and absorb all the heat that has been evolved.

It is best to test the apparatus first with some fuel, as sugar, whose heating value is known, that the percentage of error may be reckoned in the results obtained with the fuels to be tested.

Secondary Distributing Systems for Three-Phase Plants.

By Mr. Aug. J. Bowie, Jr., in *Elec. World*.

It is generally recognized, where lighting is at all heavy, that transformers with secondary mains are much more economical than an individual transformer system. In general, anywhere from 25 per cent. to 70 per cent. transformer capacity can be saved by putting several customers on the same transformer, and not having to supply capacity for all connected lights, as would be necessary in the case of individual transformers.

Among the advantages of the use of a secondary system, is the greater safety, due to not running the high tension wires around indiscriminately, the convenience in connections and disconnections and the economy in the cost of the same, in the cost of transformers and in the efficiency of the transformers themselves due to their larger size.

To offset these advantages, there is the cost of secondary mains, besides the additional drop in the same. A secondary main system may be easily carried to excess, by the use of too large secondary wire, by attempting to feed too far, or by bad judgment in the location of transformers or mains. In many places will be found wire as large as No. 00 where No. 4 wire would have been of ample size.

It is evidently of first importance, to have the voltage drop in the secondaries small. A maximum drop of 2 per cent. will give good results and is generally permissible.

Having decided to put up such a system, the first point to be decided is the manner in which the secondary shall be run. There are six different systems practicable, each of which has its advantages and disadvantages. They are as follows:

1. Two-wire system. 2. Edison three-wire system. 3. Three-phase delta with two transformers. 4. Three-phase delta with three transformers. 5. Three-phase *Y* with three transformers. 6. Three-phase *Y* with two transformers, one leg being left out.

1. *Two-wire.*—This should be used only when the distance fed is short or the lighting is not heavy. No balancing is required, of course, so that this is the simplest of all the systems.

2. *Edison three-wire.*—This is about the best system of all for general use, as it gives almost as good efficiency of copper as the *Y* connection, and is also much easier to balance. For residence lighting in particular, it is especially fitted.

3. *Three-phase delta, two transformers.*—This system gives very poor use of secondary copper. Lights should not be connected across the legs where there is no transformer, since the drop due to current in the transformers drawn from this phase is excessive and, if the three phases were equally loaded with non-inductive loads, only 87 per cent. of the transformer capacity would be available. Provided the two phases with the transformers alone were equally loaded, the common leg would carry $\sqrt{3}\times$ the current in each of the other legs.

4. *Three-phase delta, three transformers.*—This likewise gives very poor economy of secondary wire. For best use lights should be connected equally on the three legs. One good point about this system is that if the load is not balanced, the three transformers help each other out.

5. *Three-phase Y, three transformers.*—This system has the advantage of the highest efficiency in the use of secondary wire, but the transformers are entirely independent and cannot help each other out. However, if the primary fuse of one transformer were to blow, it would put out only the lights connected to it.

6. *Three-phase Y, two transformers—one leg being leg left out.*—This system is the same as No. 3 except that the secondary of one of the transformers is reversed. It has an advantage over No. 3 in the much better use of the secondary copper. With a balanced load the current in the neutral is just equal to the current in each of the legs. If the lines and the load be practically non-inductive, then for small secondary losses, the volts drop = 1½ × volts drop in the case of the Edison three-wire system. It has the additional advantage of balancing the primary loads on a line on two phases.

While it may seem that No. 5 will give the best results in so far as balancing the primary load is concerned, yet in general, suitable balance may be easily obtained by balancing the different transformers on the different phases independently of the secondary system. It is one thing to work out a three-phase *Y* system on paper, but it is quite another thing to balance it properly in practice, where all kinds of wiring are encountered, and where even if by any chance the lights in a building should happen to balance in number, yet they may be arranged so that in the ordinary course of events, none of the different legs will burn at the same time. Moreover, there is quite a difference between balancing on two legs (as in the case of an Edison three-wire system), and balancing on three legs. Still, there are often places where a three-phase four-wire system is a good thing, for downtown lighting especially, since small three-phase motors may be put on the mains in addition to the lighting business, provided the system be large enough not to let them affect the voltage appreciably. Also if the lighting is very thick, suitable balance may be obtained without difficulty.

It would, however, be well, in case any large lighting were to be installed, to have the wiring done, either by the company or under their supervision. This, unfortunately, is often not possible. Systems Nos. 3, 4 and 5 will allow the use of three phase motors, without additional transformers. As a general rule, however, it is best to provide separate transformers for the lighting and power, as the loads usually overlap in the winter, making the service bad. For residence lighting the

Edison three-wire is preferable to all other systems, not only because it is easier to balance than the "Y" system, but also because all the transformers can be combined into one.

Balancing.—The subject of proper balancing of secondaries is one which is often overlooked. There seems to be a kind of hap-hazard method of putting the lights on, and letting the system take care of itself. For example, the writer has seen one transformer with an Edison three-wire secondary (running in two directions from the transformer), where all the lights in one direction were on one leg, and those in the other direction on the other leg—the wires without taps evidently being there for the sake of appearance. In another case with an Edison three-wire, there were 250 lights on one leg, and 47 lights on the other leg, and the primary current into the transformer showed that the transformer was somewhat overloaded.

In order to balance the lights on any secondary system, there should be provided some form of block book, so that one can work intelligently. Account should be kept of the location of the lights, the legs on which they are, and of the probable time of burning the lights. It is unnecessary to go too much into detail about the last mentioned subject, but one should have a good idea about it, and the work of this sort should be in charge of someone familiar with the lighting of the places in question. In places where more than two wires are run in, account should be kept of the number and class of lights on each leg, and these places should not be passed by as balanced because all the legs happen to run in. Also, it is not necessary to run all the legs into one place, unless the lighting be large enough to justify it, as it is often well to balance different places against each other. In one case which the writer recalls four wires of a three-phase "Y" system ran into one store where there were 21 lights on one leg, 15 lights on another leg, and only 1 light on the third leg. This had been supposed to be balanced. The main point to be aimed at in balancing is to do so for full load; but it is also well to keep some kind of a balance at other times. With a block book this is not a difficult thing to obtain. When such a book is once properly made out it requires very little trouble to keep it up, and it soon pays for its existence.

In the controversy between single-phase and three phase systems, undue stress is often laid on the difficulty of properly balancing the latter. With a plant of any size, this difficulty is largely imaginary, if only a reasonable amount of care is used. In balancing a three-phase system it is well to begin at the end of each of the primary branches, and to balance the transformers going in; and also balance the totals as well as possible on the mains from which the branches go. In this manner the best possible use can be made of the primary wire. Thus there is an advantage of saving 25 per cent. of the copper in the mains and branches, over either single-phase or two phase. If some of the branches are not long, and the lighting is not very heavy, it is unnecessary, of course, to run more than two primary wires.

In order to show how closely it is possible to balance a three-phase system by the methods mentioned, in one station with which the writer was connected, the output of one high tension lighting panel was about 175 amperes per leg at 1,000 volts, The system was balanced without any reference to the ammeter readings, account only being taken of the transformer capacities at the different locations. The result was that the three ammeters read within 2 per cent. of each other at full load. This was as closely as they could be depended on, being station instruments.

As far as keeping a system balanced is concerned, it is not a difficult task, for if a transformer is to be changed to another leg, all that is necessary is to change one of the primary wires.

The accompanying table shows the relative weights of wire for comparison of distributing systems:

System.	Weight of Wire.
1. Two-wire	100
2. Edison three-wire	37½
3 Three-phase delta, two transformers	93¾
4. Three-phase delta, three transformers	75
5. Three-phase star, three transformers	33¾
6. Three phase star, two transformers (1 leg not connected)	56¼

The same efficiency, in the six secondary systems discussed. All wires in use in any one system are supposed to be the same size.

Determining the Size of Gas Pipes.

By Mr. W. Grafton.

What size of pipe must be laid to supply a certain number of lights? is a question the gasfitter is frequently called upon to solve. The chief factors that affect the solution are the distance to which the gas has to be conveyed, the pressure that is available for the transmission, and the number of lights or quantity of gas to be supplied. Most calculations make no allowance for obstruction by water or other deposits apart from friction, which tends to check the flow of gas through pipes. The kind or quality of gas influences the amount discharged.

Gas pipes, unlike most other pipes, are always running full capacity of bore independent of the diameter and length; but the friction of the gas against the internal surface varies in the different pipes according to their size. The smaller the pipe the greater the friction per unit of gas delivered in a given time. Therefore, when gas passes through pipes the velocity of its motion is consequently greater at the axis than it is at the periphery. It is usual to assume that the mean velocity of the flow of gas in a round pipe is the same as that at a point situated at a distance from the periphery equal to one third of the radius. This, however, is only approximately correct, and Herr Jurisch has shown this to be so by a number of experiments. When a greater degree of accuracy is necessary in a determination of this kind, the velocities of flow at various distances from the side must be measured and the average value deducted therefrom. One series of determinations may be cited where gases were allowed to pass through a leaden pipe of 10.75 inch radius. The velocities in feet per second were measured by a Fletcher's anemometer at different distances from the side. At 1 inch, 5.038; at 2 inches, 4.514; at 3 inches, 4.945; at 4 inches, 5,342; at 5 inches, 5.710; at 7 inches, 6.056; at 8 inches, 6.056.

The retardation due to skin friction is here well shown. Now the mean velocity calculated over the whole cross-sectional area of the pipe is 4 97 feet per second, whereas at one-third of the radius the velocity is 5.10 feet per second, or 102.6 per cent. of the true value. The retardation in small pipes due to skin friction and length is very great, and is repeatedly neglected by gasfitters.

The following table clearly illustrates the great difference in the quantity of gas in cubic feet delivered per hour by pipes of various diameters.

Table showing the number of cubic feet that may be supplied from pipes of different diameters and lengths under 1 inch or 10 tenths pressure per hour. Dividing the cubic feet by the size of burner proposed to be used gives the number of such burners a particular size and length of pipe will supply:

Diameter of Pipe.	Length of Pipe in Yards. 15 Cubic Feet.	25 Cubic Feet.	50 Cubic Feet.	75 Cubic Feet.	100 Cubic Feet.
½ inch	44	40	37	32	27
¾ "	114	108	95	78	67
1 "	223	212	187	152	128
1¼ "	388	368	323	263	222
1½ "	613	590	507	413	345
2 "	1,280	1,225	1,070	880	750
2½ "	2,220	2,115	1,820	1,520	1,270
3 "	3,497	3,330	2,880	2,370	1,975
4 "	7,170	6,800	5,875	4,820	4,025

In order that the figures may be of everyday use the gasfitter should remember that the usual pressure on the supply varies from 1 inch to 4 inches of water, and, therefore, when it exceeds 1 inch the carrying capacities of the pipes are increased directly as the square root of the pressure and inversely as the square root of the length. That is to say, with four times the pressure the quantity delivered is doubled, while with four times the length the quantity is approximately halved.

When, however, the quantity of gas delivered under a certain pressure is known, and it is desired to know the volume that will be discharged under another pressure, the problem can be solved by the rule of three.

Rule: As the square root of the pressure is to the square root of altered pressure, so is the volume to x.

Or, again, when pressure and distance are given, to know the quantity that will be delivered by a change of distance.

Rule: Find the square root of the distances, then by rule of three. It should be remembered that the greater the distance the less will be the quantity discharged.

The specific gravity of the gas has some effect on the quantity delivered, since light gas travels faster than heavy gas, and, therefore, a smaller pipe is required for the former, in order to deliver the same volume in a given time. Illuminating gas of equal quality or candle power may vary from 0.420 to 0.600, air being 1.000, consequently a larger pipe will be required to deliver an equal volume of the gas having a specific gravity of 0.600 than one to carry a volume of gas of specific gravity of 0.420.

To find the quantity of gas delivered when the gas has a definite specific gravity to that delivered of a greater or less specific gravity:

Rule: Multiply the volume by the square root of its gravity and divide by the square root of the specific gravity in question.

According to these rules a 2-inch pipe has 4 to 5 times the carrying power of a 1-inch pipe.

[Continued from page 645.]

Experiences with the Incandescent Gas Light.[1]

By Mr. Norton H. Humphrys, F.C.S.

The topic of special interest to gas companies is the applicability of the system as an agent for public lighting. There is now a demand for a superior class of light to that afforded by a 4-feet or 5-feet flat flame burner. This is not only noticeable in our principal towns, but extends even to country villages. The most efficient way in which it has been met is by means of Sugg's or Bray's large flat flame burners. Where the gas works happen to be in the hands of the municipal authorities, or where there is a willingness to pay the gas companies about two-thirds of the sum that in many cases is cheerfully paid for electric arc lighting, very effective displays have been made. But, generally speaking, the demands on the municipal purse are already so large that no one cares to recommend an increased expenditure; and the incandescent system has been introduced at an appropriate time. It affords a means of increasing the light four or five fold, without adding to the expense. In many instances the mere replacement of the flat flame burners by No. 3 or No. 4 new pattern Welsbachs effects the desired purpose without involving costs for alterations, new columns, or even new lanterns. Large areas—such as streets, squares, etc.—can be more effectively lighted by lamps of 50 to 100 candle power than by lights of 1,000-candle power placed at proportionately greater distances apart; and therefore the system is making way so rapidly that there is scarcely any town in which it has not either already been adopted or is under trial.

In important towns where the lighting of the streets is in charge of a competent official, with an efficient staff at his command, who has both opportunity and inclination to go closely into details, with a view of carrying on the work after the most efficient and least costly methods, this department may safely be left in the hands of the public authorities. Some of the best results in street lighting have been obtained by corporation officials, who have greater facilities than the manager or other members of the staff of a gas company. But under the circumstances in which the public lighting is carried on in the average country town, the installation of the new system—including the control of every detail, even to the painting of lamp columns—had better be handed over to the gas company. Ordinary flat flame lighting may be, and very often is, left to take care of itself. Even with regard to this, efficient inspection and superintendence will be recouped over and over again. The general practice, however, in smaller towns at any rate, is to let the thing go in a slip-shod careless way. No attempt is made to secure a make of lantern that is best suited to the requirements of the district, or that is reasonably wind-proof. It is even too much trouble to keep the posts upright, and some of them have listed 4 to 6 inches out of the perpendicular. Many lanterns are simply shaken to pieces, rather than worn out by fair usage, because they are not firmly secured, but simply placed in loose cradles. Observations from the window of a railway carriage, taken during a journey across country on a fairly blusterous night, will substantiate the statement that a great deal might be done to improve the public lighting with the ordinary flat flame system. But it cannot be too clearly understood that this sort of thing will not do with the incandescent gas light, which must be under the care of a competent and painstaking superintendent. To hand the thing over to an ordinary body of lamplighters and their foreman is simply to court failure.

There is an impression abroad that new lanterns, at least, are indispensable to the success of the incandescent light; and it is fostered by the claims of makers of "lanterns specially suited to the system." Certainly great improvements in the construction and design of lanterns have been made, chiefly in the direction of reducing the air openings; but I have not yet seen the lantern which is so far improved as to warrant the rejection of a good ordinary pattern in its favor. The ordinary plant can be adopted for the new burner at a moderate cost, *if in good condition;* but if the lanterns are already shaky and badly worn, the difficulties and the expense are increased, and the engineer may find himself face to face with the problem of whether the old plant is worth patching and altering. It is, however, simply a question of renewing, and not of rejecting an antiquated and useless pattern in favor of one of more recent fashion. The flat flame burner has always been treated in practice as both wind and shock proof; but obviously some modifications are necessary in order to protect the mantle from the action of wind, and from the shock or vibration due to the exigencies of ordinary town traffic. During the past winter, I have had in regular operation three or four makes of the new kind of lantern, claimed to be especially constructed for the incandescent system, and also some lanterns of the old or ordinary type, which were slightly altered in our own workshops; and I have not been able to find that any make affords particular advantages in the matter of resisting wind. Not one of them can be depended upon to preserve the naked mantle absolutely steady in stormy weather, or effectually prevent a naked flash light from being extinguished by rough wind. In sheltered localities, the naked mantle may be used with some degree of success; but in exposed places, corners of streets, etc., a cylinder or bulb is an absolute necessity—not so much for the preservation of the mantle, as to maintain the flash light during the daytime.

The consumption of mantles is much greater in the central and busiest portion of a city than in the suburbs. The lamplighters report faulty lamps both at lighting and at extinguishing time. In side streets and in the outskirts there is no great difference in the number of morning as compared with the number of evening reports; but in the principal thoroughfares the evening complaints are always more numerous than the morning ones, except on Sundays and holiday times. This shows that the usual conditions of business traffic are responsible for some mischief, and inquiry proves that accidental blows from planks, ladders or cumbersome loads, an occasional knock from a passing vehicle, and the vibration caused by a traction engine with a load of several trucks of bricks or of rough timber, are the chief causes of this trouble. Most people suppose that the lamp posts are simply intended and used for the support of the lantern; but the introduction of the incandescent system is a means of finding out that they are made to serve a number of different purposes. A post at the entrance to a builder's or carpenter's yard is in continual danger of receiving a sharp knock from the ends of planks or scaffold poles. One near a brewer's will occasionally get a barrel rolled smartly against it. Other troubles are not so easily discovered and call for a little amateur detective work. One thing we have found it necessary to do is to forbid the beating of mats or rugs against the posts. They are also utilized as a tethering post for horses, and in back lanes for taking one end of a clothes line. In fact, the odd uses of lamp columns are so numerous that the tenants of the adjoining premises might be fairly called upon to pay a small rent as a recognition of the convenience.

All this, however, does not come under the head of fair wear and tear; and possibly some of the published instances regarding heavy mantle consumption may be due to including it as such. As observed in the case of private installations, a record should be kept of the mantles used at each lamp and the special culprits marked out for particular attention. It is an extravagant plan, because one or two lamps have proved to be troublesome, to fit up anti-vibration appliances thoughout. A little experience and good judgment will indicate where they are really necessary; but in cases of doubt it is preferable to feel the way. Just as there are unusually bad, so there are extraordinarily good instances. Sometimes we cannot find out for a time why one lamp will require a mantle every week; and at others we are puzzling why another in an equally exposed or dangerous position should go for two or three months without trouble. One very obvious conclusion is that much of the difficulty experienced in busy streets is due to local defects—such as the lamp post not being firmly fixed, the service pipe being loose in the ground, or the upright pipe having a great deal of play in the column. The lamplighter, when cleaning the lamp, will observe if the service is loose enough to allow lateral oscillation of the burner. Evidently a burner on the end of a 12-foot length of wrought iron pipe is like a light flower on a flexible stem. The remedy for this is to pack round the pipe at the head of the column, so as to hold it firmly. The column itself may be filled with non-conducting waterproof material—such as soft pitch—or a kind of collar may be made; but in any case the service pipe should be secured rigidly to the column and not to the lantern. There will always be a certain amount of vibration of the lantern; so the hole for the admission of the upright should be large enough to leave a good clearance all round.

Lamp columns intended to carry incandescent gas lights should be heavy, strong, and so firmly secured in the ground that they will remain perfectly upright and plumb, and will stand stiff and rigid against strong gales of wind, when the lantern is attached. This has not been regarded as a necessity with flat-flame burners, and a few observations on the top of a lamplighter's ladder during windy weather will show

[1] *Journal of Gas Lighting.*

that many posts have an appreciable movement—more especially long ones intended for high-power lights, and which therefore carry large lanterns. Incandescent burners fixed on such posts may be observed to blink in unison with the gusts of wind. In one case a lantern suspended from a heavy and elaborately foliated cast iron sign in front of a hotel was found to have a play of 4 or 5 inches, or sufficient to swing the mantle off the burner; but the incandescent gas light was not rejected as a failure. The swinging was stopped and the whole secured more firmly, with the result that the lamp remains in use and gives a creditable mantle record. With regard to lamp posts listed out of the perpendicular, the town surveyor may have a sufficient sense of neatness to object to the presence of practical illustrations of the leaning tower of Pisa in the streets; but no inconvenience arises in practice, in connection with the use of flat-flame burners. The incandescent burner must, however, be so set that the mantle hangs quite upright. A slight list in any direction away from the perpendicular is sufficient not only to cause irregularity in the light, but also unequal heating, to the detriment of the mantle.

As a lamp post is supposed to be a permanent structure, some little care may reasonably be spent upon the fixing; but frequently it is simply dumped into place, and the ground rammed round it, with no more attention than would be bestowed on a scaffold pole. If it is not placed on a firm bed, it cannot be expected to keep strictly upright. The bed should be well rammed and covered with a flat stone of sufficient size—worn-out paving flags will answer the purpose—to receive the footplate of the column. If the soil is weak or soft, or liable to be reduced to this condition by the percolation of water, concrete may be used. No particular rule need be laid down, since conditions vary widely. Some posts are fixed on the curb of the pavement, or in heavily macadamized roads, and others on made ground with a loose gravel covering. Not only the method of fixing, but the area of the footplate and the part below ground, can be varied with advantage. When set in a pavement, for example, the foot need not be larger than the lower part of the column; but this pattern is quite unsuited for fixing in loose ground. Frequently, however, the posts are ordered from the maker's pattern book, without the slightest consideration as to the nature of the soil in which they are to stand. The same reasoning applies to bracket supports. Columns are preferable to brackets for several reasons; but in some localities there is no choice. The need for rigidity was never rendered evident with flat-flame gas burners; but if a bracket must be used for an incandescent burner, it may be worth while to strengthen or stiffen it, which is usually a very simple and easy matter. Claws are preferable to cradles for supporting the lanterns, as enabling them to be rigidly connected to either the column or bracket; but with the aid of some copper binding wire a lantern can be securely tied in a cradle, so that it will not shake with the wind. I am now using some dozen of lanterns fitted in this manner; copper wire having been passed round the studs on the four corners at the bottom, and tied to the uprights of the crade, with satisfactory results.

(To be Concluded.)

On the Methods Employed in the Analysis of Commercial Ammonia.

By Messrs. A. Lunge and W. Hefter.

A certain number of papers have been recently published having for their subject the analysis of commercial ammonia.

Lange and Hertz (*Zeitschr. f. Angew. Chem.*, 1897, 224) collected the ammonia in an open receiver, while Bunte and Eitner (*Journ. f. Gasbel. und Wasservers*, 1897, 174), the same as Urban (*Chem. Zeit.*, 1897, p. 720, and *Moniteur Scientifique*, 1898, p. 68), put the reservoir in direct communication with a closed vessel, and filled this latter by pressure. The method utilizing a closed vessel would have the advantage of preventing any error resulting from evaporation during the collection of the sample.

We now propose to review these different methods. We will first briefly describe the Bunte-Eitner method. Into a glass pipette furnished with a stopcock at each end, we pass the ammonia directly from the reservoir and weigh it. We then place the pipette in a vertical position and connect it with three absorption tubes filled with solid potash, the weights of which have been accurately determined. We then open the upper stopcock of the pipette, so as to allow the gaseous ammonia to slowly traverse the potash tubes. After the evaporation of the liquefied ammonia we place the pipette, in a horizontal position, in a hot-air oven, which must be gradually heated to 70°–80°; at the same time we pass a current of dry air, free from carbonic acid, through the apparatus for some time.

If it were true that this method gives accurate results, we ought to find the impurities which accompany the ammonia in the absorption tubes, such as water, pyridine, naphthaline, ethylic alcohol, acetonitrile, benzol, etc. But in practice this is not the case; all these bodies are volatile at 70°–80°; they are carried away with the current of gas, and are only found in minute quantities in the absorption apparatus. It is therefore evident that the method in question does not give anything like exact results.

It is true Urban has improved the Bunte-Eitner process, inasmuch as, leaving the absorption tubes alone, he weighs the residue from the evaporation, after heating to 30° only. It is a fact that a certain quantity of ammonia remains dissolved in this residue, but the resulting error is so small that it may be neglected.

For the purpose of comparing Urban's method with that of Lange and Hertz we have prepared different mixtures, of which the composition was accurately known. These mixtures were made with pure ammonia (with 0.2 per cent. residue), with benzol, alcohol, pyridine and water, and with residues from various samples of ammonia. The following are the results we obtained:

Nature of Impurity.	Calculated Per Cent.	Found Afterwards. Urban.	Found Afterwards. Lange and Hertz.	Per Cent. Urban.	Per Cent. Lange and Hertz.	Mean
Benzol	1.5	0.99	1.7	66	113	—
"	1.5	0.75	1.5	50	100	—
"	1.5	1.13	1.5	75	100	—
"	1.5	0.77	1.0	51	67	—
"	1.5	0.76	1.0	51	67	—
Pyridine	1.0	0.65	1.2	65	120	—
"	1.0	0.70	1.1	70	110	—
Water	1.1	0.91	1.2	83	109	—
Alcohol	1.0	0.80	1.6	80	160	—
"	1.0	0.79	1.8	79	180	—
Alcohol and acetonitrile	1.0	0.79	1.5	79	150	—
Alcohol and benzol	1.3	0.79	1.4	61	108	—
Benzol and pyridine	1.0	0.80	0.9	80	90	—
" " "	1.0	0.66	1.1	86	110	—
Residue A	1.0	0.54	1.1	54	110	82.0
"	1.7	1.41	1.9	83	112	97.5
Residue B	1.1	0.74	1.5	67	136	101.5
"	2.2	1.54	2.8	70	127	98.5
"	2.7	2.04	3.1	76	115	95.5
Residue C	1.0	0.80	1.3	80	130	105.0
"	1.7	1.33	2.2	78	130	104.0
Mean of all the samples.	—	—	—	72	120	96.0
Mean of the 7 last samples	—	—	—	72	123	98.0

It will be seen that neither of these two methods is rigorously exact; Urban's method gives figures which are too low, while those of Lange and Hertz are too high. As there can be no loss of ammonia in the taking of the sample, it must be admitted that a portion of the impurities has been mechanically carried over by the ammonia gas. The quantity of these entangled impurities varies considerably from one sample to another—it depends on the nature of the body present. Benzol and pyridine are the most easily carried over, while alcohol and water are more difficult; among the mixtures, that composed of equal parts of alcohol and pyridine is the most difficult to be carried over.

These considerations enable us to explain how it is that sometimes the Lange-Hertz method gives perfectly exact results. We have also a word to say about the method used in America and Australia for the examination of commercial ammonia. In these countries it is required that the ammonia, transferred from the reservoir to an open vessel, should have a boiling point of 33.7° C.; a higher boiling point denotes a less pure product. But we have observed that this method is very unsatisfactory, and that it does not enable one to distinguish with certainty between a product containing 0.1 per cent. of impurity and another containing 1.0 per cent.

Thus all the methods which have up to now been recognized in the analysis of commercial ammonia are sullied with grave errors, and cannot be used when scientifically exact results are required.

But, we may ask, is it really necessary, commercially, to have absolutely correct results? Liquid ammonia is almost exclusively used for the manufacture of ice, and it is evident that its refrigerating action will be the greater the purer it is; but, on the other hand, we do not think that small quantities of impurities can have any very serious action. It is not really indispensable to know whether a given ammonia contains 1 per cent. or 1.2 per cent. of impurities; we must,

however, insist that such impurities should not exceed a maximum limit, which will vary from one case to another, according to the wants of the consumer. Now to determine the permissible amount of these impurities, which of these two methods in question should we advise? One gives too high results and the other too low; but the mean of the two more often approaches the truth, as will be seen in the above table.

The Lange-Hertz method is very easy to perform, and we do not hesitate to recommend it, whatever may be said for Urban's, until we have succeeded in finding a really exact method.

Some Notes on Purification.

[A paper prepared for the last meeting of the Eastern Counties Gas Managers' Association, by MR. A. L. CLARKE, Maldon, England.]

I had intended to treat this subject in a much more exhaustive manner than I have done, but I shall content myself with bringing before your notice a few remarks which I hope will call forth a good discussion.

In the early stages of purification, which is always spoken of, and truly so, as commencing in the hydraulic main, some of the heavy tarry matter and aqueous vapor is deposited, and the cooling process is commenced. We may take it that the temperature of the gas on leaving the dip pipes is from 120° to 160° F., and it is absolutely necessary, in order to keep the most valuable hydrocarbons in suspension, that the cooling process should be very gradual, or the illuminating power of the gas will be materially affected. In order that the cooling process may be gradual: 1st, the hydraulic main should be of ample size; and, 2d, the foul main should be, in the smallest works, not less than 6 inches. In most gas works of small capacity we find ridiculously small hydraulic and foul mains, and the consequence is that the gas is subjected to a large amount of friction, and some of the most valuable hydrocarbons are deposited. I do not think that enough importance is attached to this portion of the plant from the point of view of effective purification. In my own case, in a make of 17,000,000, I have substituted a 10 inch for a 6-inch foul main, and I am sure that I get far more gradual and effective condensation than I did with the 6-inch. I believe that if more attention was paid to the gradual condensation of gas we should hear far less of the eternal naphthaline question.

We may take it that the chief impurities in the gas after it leaves the condenser are carbonic acid, sulphureted hydrogen, ammonia and bisulphide of carbon. Now, the chief impurity that the washer has to remove is ammonia, and, as showing the value of efficient condensation, I may mention the fact that at a temperature of 60° F., with the barometer at 30 inches, water absorbs about 783 times its own volume of ammonia gas, and the lower the temperature of the gas the greater the proportion of ammoniacal gas absorbed; so that the colder the water in the washer the more effectively is gas purified from ammonia. Of course, there is a limit to this, as the illuminating power would be materially affected if the temperature of the gas were allowed to drop much below 50° F.

Along with the ammonia also come carbonic and hydrosulphuric acids, and although there is not sufficient ammonia to completely neutralize all the acid impurities, one wonders how long before we arrive at the theoretically simple process of adding sufficient alkaline matter to complete the neutralization of these acid impurities and completely purify coal gas in closed vessels. Certain it is that in most gas works the fact that gas contains enough alkaline to neutralize a large amount of its acid impurities is not sufficiently recognized. The liquor from the hydraulic main, for instance, has come in contact with the gas at such a temperature that a very small proportion of these acid impurities can be in combination with it, the temperature of the liquor there being, say 150° to 160° F., at which the combining power of the alkali is almost nil. If, therefore, the liquor from the hydraulic main and condenser is brought sufficiently in contact with the foul gas it is capable of absorbing a great deal more of the impurities CO_2 and H_2S.

You will see from this that far more can be done in small and average sized works in this direction than is now. In most small works I believe the hydraulic main ammonia is completely wasted. This brings me to another point I wish to particularly emphasize, and that is that by this means the quantity of fresh water used in the process of purification of gas may be very materially reduced, and the resultant liquor be stronger and smaller in bulk—a very necessary thing in small works.

In dealing with the last stage of purification, by lime and oxide of iron, I will first state the system we have at our own works, which is to place a good layer of lime at the top of each purifier, and three layers of oxide of iron underneath in each purifier. Then, as each clean purifier is put into work it is made the last of the series. We are compelled, in some measure, to follow this course, as we have a Weck's center valve, and can only work the purifiers by rotation. But I think the system has its advantages, because we remove, to some extent, the sulphur compounds. In the President's address at Rumford, last autumn, he stated that he performed his dry purification with "alternate layers of lime and oxide of iron, the boxes being worked on the rotary system." Now, I cannot see that, from a chemical point of view, there is any advantage in the system of alternate layers of lime and oxide. On the contrary—and I speak with all deference—it seems to me, rather to be wasteful of lime, although, in practice, I have no doubt Mr. Child gets better results than I do. It would, at any rate, be instructive to me if he will be kind enough to give his reasons for such an arrangement.

In a system such as I have named above, the actions and reactions would be as follows, viz.: The sulphureted hydrogen of the foul gas, on entering the first purifier, combines with the oxide of iron to form ferric and ferrous sulphide, and with the lime to form sulphide of lime, while the carbonic acid of the gas passes over the oxide and is absorbed by the lime, forming carbonate of lime. Carbonic acid being a stronger acid than sulphureted hydrogen, the sulphide of calcium is decomposed and the carbonic acid passes on to the next purifier. In this way the lime in each purifier is converted into sulphide of calcium in turn, and is then in a fit state to take up the bisulphide of carbon; so that, as this is done at a small cost, purification from the sulphur compounds is within the reach of small works, and is a better system, in in my estimation, than simply finishing up with a lime purifier.

In conclusion, I cannot help mentioning how much I agree with the President's remark as to the necessity for a gas engineer to have a good knowledge of chemistry. How much more interesting his work becomes when he understands, if only to a small extent, the marvelous actions and reactions going on hourly under his control.

The New Carbide Plant.

"O. E. D.," writing in *Iron Age*, from Niagara Falls, under date of the 27th ult., says: A few years ago, when there were good prospects that calcium carbide and its product, acetylene gas, would advance in popularity for illuminating purposes, long articles appeared in the daily papers for and against the new claimant for attention. It was predicted that it would prove exceedingly dangerous and could not be used successfully. Notwithstanding all the opposition, the manufacture of carbide has steadily increased. The plant first erected at Niagara Falls for commercial purposes has been many times enlarged. Large sums of money have been expended in tearing down and building up the apparatus used for the manufacture of carbide, until now quite satisfactory results are being obtained from the furnaces in use.

But this is not all. The plant first erected, despite all its enlargements and additions, has been found inadequate to meet the increasing demand for carbide, and a fine new plant is being erected on the lands of the Niagara Falls Power Company, east and north of the old works. This new carbide plant is about the largest electrical plant yet constructed at the Falls. It will consist of two buildings, each 864 feet in length and 80 feet wide on the exterior, also an office building. The buildings are of brick and iron, and are located beyond the village of Echota, Niagara's industrial suburb, north of the tracks of the Erie and New York Central railroads. When completed and in full operation this plant will use 25,000 electrical horse power, and have an output capacity of over 100 tons of carbide a day.

Both of the factory buildings are now being erected. The first one will have a 3-story front section, 132 x 75 feet, which is to be used as the pulverizing department. Back of this will be the dust collector room, 30 x 75 feet in size, and next will come the furnace room, the dimensions of which will be 395 feet long by 75 feet wide. On each side of this furnace room there will be three distributing points for the electrical current. Back of the furnace room will be the shipping and packing departments, which will occupy a space of 300 feet in length by 75 feet wide. Platforms 100 feet or more in length will run through the center of this room along railroad tracks to be laid there, in order that cars may be loaded with the greatest possible ease and rapidity. An upper floor will afford storage facilities. Of raw material and product the Union Carbide Company expect to handle about 30 or 40 cars a day.

The second building stands about 75 feet distant from the first building, and, with the exception of the 3-story section in the front, is an

exact duplicate. In both buildings especial attention will be given to dust collection in order that the comfort of the men, while at work, may be as well cared for as possible. The structural iron for the buildings is being furnished by the Berlin Iron Bridge Company, and the Penn Bridge Company will furnish the storage bins. The elevator and conveying machines will be supplied by the Jeffrey Mfg. Company.

The transformer equipment in connection with this plant will be as notable as any at Niagara. The Wagner Electric Mfg. Company will furnish transformers for about 15,000 horse power capacity, consisting of 7 static transformers of 2,000-horse power, and two static transformers of 500 horse power, together with the necessary switchboards and apparatus. These transformers will be of the oil filled type, having water coils for lowering the temperature of the oil. Their guaranteed efficiency will be very high.

The Westinghouse Electric and Mfg. Company will also supply the Union Carbide Company with 10,000-horse power capacity in transformers, which will be well up to their established standard. In addition to this the Westinghouse Electric and Mfg. Company will supply the Niagara Falls Power Company with seven 2,500-horse power transformers, involving the largest units ever manufactured. They will be of the standard oil insulated, water cooled type, the cooling being effected by the circulation of water through coils of brass pipe immersed in the oil, thus doing away with fans, pumps, blowers, etc. These transformers will be used for stepping up the two-phase 2,200-volt current from the generators to three-phase 4,400-volt current for the use of the Carbide Company. They may also be used in other ways.

At present the Niagara Falls Power Company are engaged in constructing a new power cable conduit, extending from the big power house to the new carbide plant, a distance of 12,000 feet. This conduit will consist of 36 3¼-inch vitrified tile, laid in a nest and sheeted with cement, a style of conduit that is very popular with the Niagara Fall Power Company, they having already built long sections of it.

It is hoped to have the new plant in operation by July 1.

[From London *Engineering*.]

Municipal Greed.

We are all proud of the activity and enterprise displayed by our municipalities. We see in them a reflection of the spirit which has enabled Englishmen to plant self governing communities all over the world, and to manage the affairs of distant colonies with conspicuous success. Orderly Government is a passion with our race, and shows itself in all classes. The keynote of our system is the management of affairs by men who command the confidence of their neighbors, and not by experts educated and trained for the purpose. We put civilians at the head of our naval and military departments; we put country gentlemen, business men and shopkeepers on the bench, while the affairs of our towns are managed by all sorts and conditions of men, from dukes down to persons of the working classes. To foreign eyes the system appears very illogical, yet it has worked well in practice, in spite of its occasional defects. Our great provincial towns are proud of the men who govern them, and proud also of the results that have been attained. The smaller towns try to imitate the larger, so far as their capabilities permit, although they sometimes raise a smile when their resources are set alongside their ambitions. Taken as a whole, our municipal government in the past has been creditable to all concerned, while its defects have been more than paid for by the public spirit that has been created, and the local patriotism which has been fostered.

Year by year the duties and responsibilities of municipalities grow and the questions to be solved become more difficult. When the principal matters were cleaning, repairing, and lighting the streets, and providing police to guard them, there was no principle to be debated. Everybody was agreed that these duties must be performed, although there might be differences of opinion as to how much should be spent upon them. But when municipalities went in for manufacturing and trading, quite a new state of affairs supervened. There was no necessity for such things to be attempted, for there was always private capital ready to take the risk, and it was a debatable question whether the enterprise would be to the advantage of the community. In the early examples of municipal trading the town usually bought out a private company, and so knew exactly what the return would be on its outlay. The question was simply one for an accountant, and admitted of very little dispute. Many of these early purchases turned out very successfully, although fair and legitimate prices were given for the undertakings, such as gas works, which were bought. Due to the fact that subsequent extensions were made with money borrowed at cheap rates, and that the demand grew rapidly owing to increase of population and other causes, the gas committees were usually able to make substantial grants in aid of the rates. The popular imagination fastened upon three things: First, that private gas companies paid 10 per cent.; second, that the gas committee borrowed its money at 3 per cent.; and third, that the rates were aided by the gas profits. Of course two of these beliefs were far from correct. When the auction clauses are taken into account the average dividend on gas stock is much below 10 per cent., while interest and redemption on municipal loans amount to a good deal more than 3 per cent. The price and quality of the gas, too, are important factors in the matter, and these are certainly not more favorable to the consumer under municipal than private management. Nevertheless, the contribution in aid of the rates was a fact which could not be denied, and its existence in some towns gave rise to a general desire for it in all, particularly on the part of the members of the councils. Then arose the municipal greed for money obtained by trading and not by rating, and with that we entered upon another phase of local life of which we cannot yet see the end, but which we know to be full of peril.

When the first electric lighting act was passed the newly born greed of municipalities for trading profits showed itself most strongly. Mr. Chamberlain, acting as the spokesman of the towns, proposed that provisional orders should run for 21 years, and that at the end of that period the municipalties should have the option of buying the plant, at a valuation, without any allowance for goodwill or compulsory purchase. It was a game of "Heads I win, tails you lose," and the capitalist did not care to play. In their rapacity municipalists had overreached themselves. Later the term was extended to 42 years, and immediately electric lighting stations, under private enterprise, were built. For a time there were grave doubts as to whether they would pay, and it was difficult to raise money for them. The towns showed very little desire to undertake such enterprises themselves; anxious as they were for trading profits they were exceedingly shy of taking risks. They wanted 10 per cent. and a gilt-edged security at the same time, and such investments are not to be had. Many of them, however, avoided the necessity of coming to a decision by the device of taking out a provisional order, and then carefully pigeon-holing it. Under the terms of the Act they had the first refusal of the concession, and by the kindness of the Board of Trade they had almost unlimited time for consideration. Gradually the information spread that an electric lighting plant could be relied upon to pay in a town of moderate size, and most of the provisional orders were acted upon in a more or less tentative fashion. In some cases, however, the municipality did not see its way to spend the ratepayers' money, and as there was an outcry for the light, it transferred to a private company a portion of its powers.

The Act gave certain considerable advantages to municipalities, but it was quickly discovered that by obtaining a provisional order, and thus disposing of it, it might be possible to screw better terms out of the ultimate concessionaire. In this way the intentions of the Legislature are frustrated, and a tax is laid on the users of the light for the benefit of the town. The business man is taxed twice over; first on his rental and second on his light. For it must be remembered that it is only in places of small size, where the immediate success of electric lighting is far from assured, that such a transference of powers takes place. If the prospects are not such as to justify the council in spending money borrowed at 3 per cent., they are certainly not good enough to justify a private company undertaking pecuniary responsibilities to the town, in addition to those it owes to its shareholders. Nevertheless, attempts are continually being made to sell provisional orders which towns do not put into execution themselves, either for money, or for some kind of *quid pro quo*, which must eventually be paid by the users of the light. We lately came across an example of this kind. The town of Southend-on-Sea obtained a provisional order about 1891, and recently it advertised for someone to take it off its hands. After eight years' deliberation the council decided that it was not prudent for them, hampered with no purchase clause, to risk the public money in an electric supply system. But they evidently thought that the terms they refused too good for private capitalists, for they invited bids, not only in money, but also by way of reduction of privileges. They asked:

"1. The amount to be paid to the Corporation by way of recouping them for the expenses incurred in obtaining the order and subsequent expenses, and also by way of premium for the concession. This may be in one payment, or, by way of alternative, an annual payment may be suggested.

"2. For what minimum period of years the tenderer proposes that the transfer shall be made.

"3. The shortest period from date of transfer at which the Corporation may resume possession of the undertaking, and the basis upon which the price to be paid by the Corporation therefor shall be ascertained. Also what length of notice would be required by the Corporation prior to taking over the undertaking.

"4. Whether the tenderer will agree within 18 months to lay down the necessary plant and mains within the compulsory area.

"5. Within what period he will lay mains in the following streets * * * in addition to the compulsory area.

* * * * * * * * * * * * * * * *

"14. What control does the tenderer propose to give the Corporation with regard to the maximum charges to be made from time to time relatively to the amount of profit earned in each year.

* * * * * * * * * * * * * * * *

"16. State proposed position of generating station, or whether tenderer would be prepared to lease a site therefor from the Corporation, at the rear of London road."

Now to fully understand the undesirability of fettering the action of the company who will undertake the lighting of Southend, we need to recall the circumstances of the town. It aspires to be a high class residential place, and also a popular seaside resort; it has no manufacturing or trading interests beyond those involved in catering for the inhabitants and visitors. Therefore, the first business of the Council is to make it popular, and to keep it ahead of the other towns which are rising in its immediate vicinity. To do this they need to foster every enterprise which promises additional conveniences or attractions. It is a wise policy to spend money freely for such objects, for it will bring in an immediate return in increase of rateable value. No sum that can be reasonably expected from profits on municipal trading, or from the sale of concessions, can compensate for even a small fall in rents. It is killing the goose which lays the golden eggs to render the supply of necessaries, or even luxuries—and the electric light is fast becoming a necessity—unduly expensive in such a town. Yet what else can be expected when hard conditions are imposed on a bargain which it is not considered safe for the town to accept for itself? The term of 34 years yet remaining on the provisional order is not unduly long for the creation of a sinking fund, and, if it be reduced, the annual sum for redemption must be increased. This can only be done at the cost of the consumer, for it is upon him that the extra expense must ultimately fall. He must pay the premium on the cost of the order, if the Board of Trade will permit of such an improper proceeding; he must find the sinking fund; he must provide interest on the cost of mains laid in streets in which there is no demand; he must contribute towards the increased cost of the station, due to its position being fixed in a hurry; and so on. In a word, electric light is going to be dear in Southend, if the present ideas of the Council are carried out.

We have often wondered what kinds of businesses the Councillors follow—and such men are by no means peculiar to Southend—who seek to impose restrictions like these on a new industry. One would have thought that their private experience would have shown that it is the customers of the successful tradesmen who get best served both in quality and prices. It is the man with a big turnover who makes a fortune, not the one who makes a large percentage of profit on a small trade. An electric lighting company has the strongest possible inducement to treat the inhabitants of a town well, since it can only make a profit on a relatively big demand. It has a certain number of heavy fixed expenses which cannot be reduced, and, in addition, the working expenses vary almost inversely with the output. The works costs in this country range from $\frac{6}{10}$d. up to 6d. per unit, depending mainly on the output and the load factor. Every reduction of rates brings in new consumers, and each consumer spends, on an average, £40 with the local tradesman in wiring his house. Yet a town council will often think more of getting a few hundred pounds out of the sale of a concession than of adopting liberal measures which will enable the cost of the light to the town to be reduced by £1,000 a year. It is a matter of experience that it is only the electric light companies which charge low rates that pay good dividends.

Electric lighting is only a small portion of the ground upon which municipalities are casting greedy eyes. Urged by their socialist members, they are desirous of entering into many industries. If they had the courage of their convictions this would not be an unmixed evil. As it is, they are hung up between their aspirations and their fears, and in many cases will neither do the work themselves nor let others do it. It is the custom of Parliament to make the consent of the town council necessary for all public schemes in a district, and little can can be done without their concurrence. Such councils, being generally composed of men having no experience in affairs of magnitude, are most difficult to treat with. They are afraid of making a bargain lest they get the worst of it, and they dare not undertake the risk themselves, fearing the wrath of their constituents if it fails. Hence they devote their energies to delaying every question. They discuss and discuss, and send deputations to the ends of the earth to inspect, and finally do nothing. In the meantime the townspeople are carrying on their business at a disadvantage, and, as a nation, we are falling behind the world. It is easy to play a safe game at someone else's expense, but it is not in that way that the British Empire has been created, and it is very much to be doubted whether it can be permanently carried on in such a way.

Some Suggestions as to the Care and Management of Gas Engines.

[By Mr. E. C. Hathaway.]

The constantly increasing use of gas engines for small powers, with the many different types on the market, leads the writer to believe that a few general suggestions for their operation and care will not come amiss, bearing in mind that the gas man in the smaller towns is being constantly brought in contact with them, and is called upon to give directions and suggestions as to their installation and starting, but more especially to prescribe a remedy or locate the cause when they fail to qualify, as they often do. This latter is not usually due to any inherent fault of the engine (though many poorly built ones are placed upon the market), but rather to careless handling and improper attention.

The usual amount of stress laid by the dealers on the supposed fact that an explosive motor needs little or no attention, or only that necessary to stop and start it, leads the consumer to largely neglect the attendance feature, consequently many engines are condemned and thrown out, their only fault being that they would not run themselves entirely; whereas, were they accorded the care taken of the average electric motor used for small powers, they would have earned a reputation for reliability which unfortunately they now lack.

Two features, if closely looked after, that will almost insure perfect performance, are compression and ignition, which two, being to a large extent interdependent, will be taken up at once.

In the 4-cycle engine of the Otto type the different functions are performed by the sweep of the piston through four strokes, or two whole revolutions. Beginning with an impulse which is given by the piston on the outward half of the first revolution, the exhaust valve opens as the piston begins its return journey and closes at its end. When the admission valve opens the vacuum caused by the next outboard stroke draws in the mixture of air and gas, and on the return inboard stroke the mixture is compressed for the explosion and ignited at the end by the tube or electric igniter, as may be. To get the highest duty from the engine this compression should be as near perfect as possible, consistent with the design of the engine and the amount of clearance it has, and to obtain this the piston and packing should be as near gastight as possible.

This being solely a matter of the bore of the cylinder and size of the piston, as compared with said bore and the perfect fit of the piston rings, a word may be said in such regard.

In most small engines the piston head is turned slightly smaller than the cylinder, under the supposition that the cylinder walls, being cooled by the water jacket, will not expand as much as the piston head, consequently, when the parts are up to their normal heat, unless some allowance is made, the piston will be gripped by the walls and a stoppage occur.

This, while true in theory, does not work out in practice, for in some small engines repaired by the writer, and which had worked to perfection, the difference was so small that the piston had to be driven in the first time and the engine driven by a belt from some convenient shafting, oil being copiously applied till the two were worn to a bearing.

Ordinarily the packing ring used is the common cast iron ring turned larger than the head and then sawed apart, as in either Figs. 3 or 1. These are sprung into channels turned in the head casting, and staggered to prevent leakage and held in place by small pins coming in the cut as shown. The nearest to a perfect packing ring that can be used for this purpose is shown in Fig. 2. It is an adaptation of the Dunbar packing for steam work, which was used by the writer six or seven years ago, and the test of time has proved its utility.

One or two manufacturers to whom those were suggested are now using them. They are somewhat more expensive than the common ring, but can easily be made for 25 cents a diametrical inch, and their increased efficiency and long wear will pay their cost many times over.

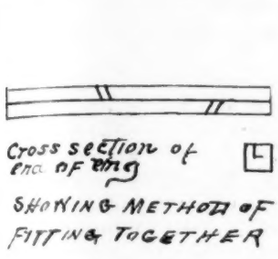


Fig. 2.—Showing Two Rings as Sprung Together.

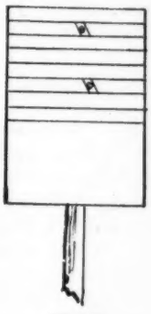


Fig. 3.

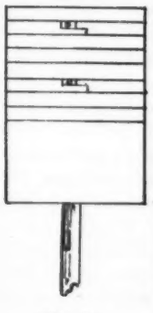


Fig. 1.

The interdependence of compression and ignition before spoken of is, of course, well known, the rapid evolution of heat from quickly and highly compressed mixtures assisting materially in igniting them. Mixtures non-explosive at atmospheric pressure are rapidly ignited at 30 to 40 pounds above it. Next comes the method of self-igniting, of which two are in vogue—electricity and the hot tube. The advantages of the former are obvious, as the timing can be made very accurate, taking place precisely at the same instant under all conditions, making it very desirable; but the difficulty of getting successful igniters, and the cost of primary or storage batteries as a source of current, militate against it.

Many igniters so-called consist substantially of a device where two points are separated inside the cylinder. They are rarely successful, as for some reason, unless the points are scratched or dragged apart, the spark is not satisfactory; and in no case will be so unless the points are platinum tipped.

Next comes the source of the current. If a primary battery is used none but one giving a large amount of current at high potential is satisfactory. Perhaps the best type is the Edison-Lalande. Four cells of this battery, with good spark coil to produce the proper field discharge, will give the necessary spark, but the battery repairs are costly and troublesome, and will cost fully as much as the gas necessary to heat the tube. Storage batteries give admirable results, but the high initial cost, the difficulty of getting suitable charging current, and the trouble of recharging preclude their use.

The only really successful arrangement is the attaching of a small generator to the engine itself, the start being made with suitable battery, and after the engine comes to speed a plug is changed, cutting out the battery and cutting in the generator.

This device is used in one instance, but the generator being a magneto machine, the loss of magnetism in the fields makes it practically useless; it being a well-known fact that steel magnets, unless protected by soft iron armature, gradually lose their strength. If, however, a small generator built upon the lines of the large shunt wound type is used, with wire wound field, it can be made to do the work very successfully. The battery renewals necessary for starting will not have to be made more than once a year.

The old and reliable tube, although it has its faults, seems to fill the bill, especially if the engines are handled by those not skilled electrically. The disadvantages consist of the burning out of the tubes if iron is used, and the uneven performance of the engine, due to the tube being at times hotter than others.

The composition tube now upon the market gives good results, and is warranted to last for a year. It does not, however, heat so readily as iron, and is consequently slower. Excellent results are also gotten from the porcelain and lava variety.

The question of cylinder oil is also of vital importance, and while any high grade paraffine oil can be used many of the so-called gas engine oils are unsuitable, because they are easily vaporized at the temperature existing inside the cylinder. Magnificent results are gotten, using the 600 W-cylinder made by the Vacuum Oil Company. It is heavy, assists largely in keeping the piston tight, and samples that have been through the cylinder will be found discolored but not carbonized.

As the valves (of which all nowadays are of the poppet type) are of much importance, a word as to their care may be said. They should be cleaned frequently, and when they require regrinding the writer has found that, on account of the thin scale of oxide formed by the heat, which is exceedingly hard, the operation is facilitated by carefully removing the valve centering it in a lathe, taking care to preserve the proper bevel and taking a very light cut off it with the tool. It may then be replaced and ground tight much more readily than before. Leaky exhaust valves, of course, destroy the compression and, with a leaky admission valve, the charge will be often driven back from the cylinder causing the engine to behave in a very erratic manner. The timing valve is not of so much importance, and in many cases after the engine comes to speed it can be propped open and left so, for at reasonably high speeds, unless the tube is very much hotter than it can be gotten with gas, it will not cause pre-ignition.

We are all familiar with the symptoms of too early ignition, with its jar and slam, caused by the shock of the explosion before the engine reaches the center. If this occurs and continues after the timing valve is ground in tight, look to the key in the flywheel, and you will often find it is loose. It is no unusual thing to find, after half-a-days' work to cure an apparently leaky timing valve, that the whole trouble was caused by a loose flywheel.

In conclusion, keep the engine clean, the valves and piston tight. Studying the subject carefully, it will be found that, far from being a victim of "inherent cussedness," as is sometimes supposed, the gas engine is, if given half a chance, one of the most docile and easily operated machines in existence.

Steam Mains for Electric Supply Stations.

By Mr. R. Summerfield, in *Engineering*.

General Arrangement.—The steam mains of a central station are a very important part of the plant, but a part which does not often get attention it should do when the station is designed, and yet a badly designed steam pipe arrangement will give more trouble than almost anything else, as the high steam pressures usual in electric supply stations, from 140 pounds to 200 pounds per square inch, require very careful design and the best workmanship in the steam pipes, or trouble will surely be experienced sooner or later.

With the exception of steamships, the continuity of steam supply is perhaps more important in electric work than in any other, especially where a large amount of light and power is supplied from the same station, and in designing steam mains engineers have generally had in view the prevention of any possible break in the supply of steam to the engines, some even going so far as to have two separate and distinct mains, with separate connections to each engine and boiler; but the majority of engineers are satisfied with the simple "ring" main, which consists of an endless pipe into which all the boilers deliver their steam, and from which steam is taken for all the engines; this necessitates a double length of main, but only one connection to each engine and boiler.

In the opinion of the present writer both these systems are wasteful and unnecessary, as they double, or nearly double, the first cost and interest and depreciation on the main, and also double the loss by radiation, which loss accounts for a good many tons of coal in the year in even the smallest station.

There is no reason why a steam pipe should burst any sooner than a boiler; in fact, the chances of explosion are very much greater in the boiler than the steam pipe, and though there may be plenty of spare boilers yet the bursting of one would shut the station down quite as effectually as the bursting of the main steam pipe.

As far as the danger of explosion through excessive steam pressure is concerned, then a single main steam pipe, if properly made, may be confidently expected to last at least as long as the boilers, but the principal trouble experienced with steam mains is the presence in them of water, which, if in sufficient quantity, causes a water hammer, which may burst the pipe; this danger may, however, be made very remote by proper design, as explained further on, but there still remains the trouble of leaky joints. These are due to contraction of the lengths of pipe when only a small quantity of steam is passing, thus opening the joints and allowing the condensed water to find its way through; this gradually rots the jointing material, which in time blows out.

Now, if these joints were riveted instead of bolted, no jointing material would be required, there would be no leakage, and the pipe would be stronger and more elastic. The joints, which would be made with Adamson's flanged seams, could be riveted in place with very little trouble by means of a portable hydraulic riveter, but it would not be advisable to rivet the joints at the flanges of valves, as they might require changing or repairing.

The system which the author suggests would consist of one main steam pipe having an area at least 1½ times that required for the proper delivery of the full quantity of steam, in order that it might act as a reservoir; all joints except those connecting the pipe with valves would be riveted, the branches to the engines and boilers having riveted joints also. The main pipe should be placed over the boilers, at a

sufficient height to allow the branches, which would be taken from the bottom and not the side of the main pipe, to fall towards the boilers on one side and the engine separators on the other, thus giving any water which might get into the pipe a double chance of escape. Some engineers place a small pipe immediately below the main steam pipe, and connect the two at frequent intervals by short vertical pipes; the water drains into the small pipe, and is taken back into the boilers.

There is no need, however, for this small pipe, or for other drains on the main, if it is arranged as suggested above, and the engines are provided with large steam separators placed below the level of the cylinders and having efficient drains attached.

With regard to valves, the best practice is to place one in every branch, close to the main, in addition to the boiler and engine stop valves; a valve is often put in the main between every engine and the next, but this is not necessary if the steam piping is made strong enough; one or two valves should, however, be placed in the main in order to shut part of it down, if required. All valves should have by-passes.

Fig. 1.

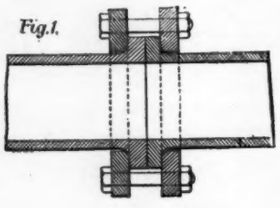


Fig. 2.

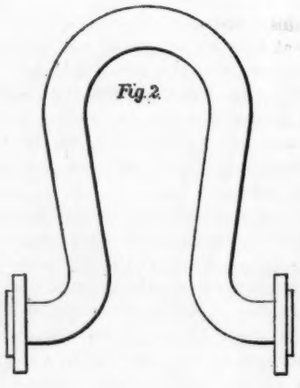
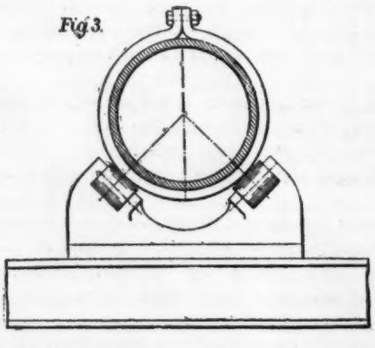


Fig. 3.



Material.—Cast iron is not used now for pressures of over 100 pounds per square inch, at least not in electric light stations, the steam mains being nearly always made of boiler plate steel, lap welded, with the flanges welded on; small pipes are made of weldless steel tube. These steel steam pipes have taken the place of copper ones for high pressures, copper pipes being rarely used except for diameters of under 2 inches or 3 inches, or for awkward bends, but if large copper pipes are used, riveted seams are preferred to brazed ones, on account of the uncertain strength of a brazed joint.

Steam stop valves are now made with cast steel casings, the valves, seats, spindles, etc., being made of gun metal or phosphor-bronze.

Hopkinson's valves are a good type of modern stop valve. The valves should open and close fairly quickly, and be provided with large hand wheels having arrows showing which way to turn to open or close the valve, but all valves should open the same way. The tees in the main are also made of cast steel, as welded or riveted tees often give trouble.

All material for steam pipes should be of the very best quality, put together by good workmen, and tested to twice the working pressure by hydraulic power, and 1½ times the working pressure by steam before being used.

Joints.—The choice of a material for making the joints in steam pipes is important, as it is chiefly at the joints where trouble occurs. For high steam pressures soft copper gauze is generally used, which makes a very good joint; asbestos brushed over with plumbago is also used, or some compound material, such as woodite, of which there are several in the market. The joints are made in the form of narrow rings, generally not more than 1 inch wide.

Joints on welded steel steam pipes are made as shown in Fig. 1; two substantial flanges of wrought iron or steel, having the bolt holes ready drilled, are slipped loosely on a length of pipe, on each end of which a narrow flange is then welded, having a width and thickness of from two to three times the thickness of the pipe. The ends of two lengths of pipe having been brought together, a ring of jointing material is slipped between, and the joint pulled up tight by means of the loose flanges, which have their inner edges rounded to suit the shoulder on the pipe.

Expansion.—Steam mains must have plenty of room for expansion, as they expand and contract about 1 inch in every 50 feet through variation of temperature. Expansion sockets are not suitable for the high pressures used in central stations, as they will not slide when packed tightly enough to prevent leakage. The best way to allow for expansion is to place large bends in the pipe of a shape similar to Fig. 2, which makes a very elastic arrangement, especially if the bends are made in one piece, but if they are too large for this, the joints must be made in the straight sides and not in the actual bends. These bends may be placed either vertically or horizontally, according to the space available, but the horizontal position is best, as a quantity of water driven along a steam pipe might be stopped by a large vertical bend, and driven back with disastrous results, whereas a horizontal bend would allow the water to flow on and give it a better chance of escape. The bends should be placed from 50 feet to 100 feet apart, according to the number of branches on the main, a length of plain pipe requiring fewer expansion bends than an equal length which is tied down by being connected to several engines and boilers.

In order that the pipe may expand and contract freely, it should not be rigidly fixed to the building at any point, but should rest on rollers or be slung from overhead girders. If rollers are used they should not be placed directly under the pipe, as moisture may collect there, but two rollers should be used for each support, as shown in Fig. 3, and it is better to interpose a piece of iron between the rollers and pipe to take the wear. If the steam pipe is slung from overhead the rods which carry it ought not to be less than about 2 feet long, to allow the pipe to swing, and they should have screwed ends, so that the pipe can be leveled up with steam in it.

When steam pipes have to be taken through holes in walls, they should not be allowed to rest upon or touch the wall, on account of vibration.

Pipe Covering.—The determinations which have been made of the loss of heat by radiation from uncovered steam pipes vary considerably, the experiments being by no means easy to carry out with accuracy. The loss is, however, undoubtedly very large.

The following Tables give the loss for different sizes of pipes, Table I. being taken from Messrs. Babcock and Wilcox's book on "Steam," 1898, and Table II. from "The Practical Engineer's Pocketbook," 1894:

TABLE I.—*Steam Pressure Assumed at 75 Pound and the External Air at 60° F.*

Outside Diameter of Pipe.	Loss in Heat Units Per Foot Run Per Hour.	Feet in Length Per Horse Power Lost.
2-inch	219.0	152
4-inch	390.8	86
6-inch	642.1	53
8-ihch	729.8	46
12-inch	1,077.4	31

TABLE II.—*Steam 115 Pound, Absolute 338° F. Surrounding Air 62° F.*

Inside Diameter of Pipe.	Loss in Heat Units Per Foot Run Per Hour.	Steam Condensed Per Foot in Length Per Hour.
2-inch	494	.563 pounds.
3 inch	692	.700 "
4-inch	869	.992 "
5-inch	1,067	1.218 "
6-inch	1,221	1.393 "
7-inch	1,420	1.621 "
8 inch	1,580	1.803 "
9-inch	1,738	1.984 "
10-inch	1,935	2.209 "
11-inch	2,093	2.389 "
12 inch	2,290	2.614 "

Another authority states that the steam condensed in an uncovered steam pipe 40 feet long and 4 inches in diameter, is equal on the average to the steam consumed per horse power by an ordinary engine.

The following Tables give the relative values of the non-conducting substances most generally used, Table III. being taken from "Steam," Babcock and Wilcox, 1898, and Table IV. being some results of experiments on over 60 samples of simple and compound coverings, by Professor Ordway.

TABLE III.

Material.	Value.
Loose wool*	3.35
Loose lamp black*	1.12
Felt (hair or wool)*	1.0
Carded cotton*	1.0
Slag wool	.83
Fossil meal	.79
Carbonate magnesia	.76
Charcoal from wood*	.75
Paper*	.74
Cork*	.71
Sawdust*	.68
Paste of fossil meal and hair	.63
Wood (across grain)*	.55
Asbestos paper	.47
" (fibrous)	.36
Clay (with vegetable fiber)	.34
Naked pipe	0.0

*These materials are combustible and may be dangerous.

TABLE IV.

Material.	Thickness Inches.	Pounds Fahrenheit Heat Units per Square Foot per Hour.
Hair felt and burlap*	2.68	51.0
Fossil meal and cork dust	2.56	64.8
Slag wool and strawboard	2.37	66.6
Silicated pine charcoal*	2.62	78.3
Cotton batting*	2.0	79.7
Fossil meal and hair	2.37	83.9
Cork in strips*	1.81	105.3
Asbestos paper	2.0	131.2
Clay and vegetable fiber	2.62	146.0
Naked pipe	....	1,555.1

*Combustible.

As it is not advisable to use combustible substances for covering steam pipes, the materials generally chosen are either slag wool, magnesia, fossil meal, asbestos, fossil meal and hair, etc ; and of these slag wool is probably one of the most effective when put on properly ; it should be well rammed in between the pipe and a thin sheet metal covering kept at the proper distance from the pipe by iron bridge pieces; this makes a very neat covering. The compound materials, such as fossil meal and hair, etc., are generally put on as paste when the pipe is hot, the outside being smoothed down and painted when dry ; these materials make good coverings, but some of them get rotten after a time, crack, and fall away. The asbestos and magnesia coverings are sometimes put on as paste, but generally in sections of the proper thickness, fastened to the pipe by means of thin metal straps. Some engineers cover all the joints, but the advantage of this with bolted joints is questionable, on account of leaks ; riveted joints could, of course, be covered. The radiation from flanges, however, is, as we have said, an important matter, and should not be neglected. No covering should be less than 1 inch thick ; 2 inches to 3 inches is the usual practice.

The Effect of Sizing on the Removal of Sulphur from Coal by Washing.

By MR. CHARLES C. UPHAM.

Not long ago a few acres of coal land in the Connellsville region of Pennsylvania were sold at the rate of $1,500 per acre. While this was doubtless a "fancy" price, affected by some consideration other than that of the simple value of the coal in the tract, it may fairly be taken as an indication of a progressive and already perceptible diminution in the economically available coal resources of that famous region. This present and prospective development emphasizes the commercial importance of producing, from the inferior coals of other districts, coke suitable for use in the blast furnace.

Many of the bituminous coals of the United States would meet this requirement if sufficiently freed, before coking, from slate and sulphur, and, so far as the removal of slate is concerned, the problem is not specially difficult. There are many forms of trough, jigs and gravity washers which easily and cheaply reduce the slate from as much as 20 per cent. in the coal to as little as 8 per cent. in the coke. But to reduce the sulphur from 4 per cent. in the coal (a proportion sometimes encountered) to 1 per cent. or less in the coke (proportion demanded by the furnace manager) is not so easy.

It may be safely assumed, as familiarly known to members of the Institute interested in this subject, that, of the three forms in which sulphur usually exists in coal (hydrogen sulphide, calcium sulphate and pyrite), the pyrite is the one to be removed, as far as possible, by mechanical treatment before coking. Hydrogen sulphide, being volatile, is expelled in coking ; calcium sulphate, or gypsum, is not practically removable by preliminary treatment, and remains in the coke, while pyrites (the most abundant source of sulphur in coal) may be, to some extent, oxidized, with removal of its sulphur, in the coke oven, but can be, by reason of its high specific gravity, more advantageously removed by mechanical treatment before coking.

Concerning the removal of sulphur in the oven, it may be observed, in passing, that this result (at best only partial), seems to depend upon something more than the simple oxidation of the sulphide. The presence of water—that is, of hydrogen as well as oxygen—apparently promotes the expulsion of sulphur in a volatile form. It has been observed that coal charged wet into beehive ovens will yield a coke containing less sulphur than if charged dry, and the same is probably true of closed retort ovens ; but in the latter case, no doubt, experience would prove, as it has in the former case, that wet coal requires a longer time in coking.

It is therefore evident that the pyrites should be removed, as far as practicable, before the coal is charged into the coke oven, and it is the purpose of this paper to call attention to an element in this preliminary treatment which is, according to my observation, very generally neglected in the washing of coal in this country.

It may be proper to say here that this point was forced upon my attention in connection with certain experiments on a large scale (which need not be more particularly described at present) in which the presence of pyrites in coal was found to be disadvantageous. I was, consequently, led to study the general practice in the washing of coal, and to make certain experiments, described below.

When coke ovens are located at the mines, the slack produced in the ordinary screening of the coal for market is very commonly washed and coked. But in many cases the coal is treated just as it comes from the screens—in pieces varying all the way from an inch cube down to dust—while in few, if any, cases is the slack separated into more than two or three sizes. Of course, in the process of separation by specific gravity, pieces of coal or slate with adhering pyrites, having an average specific gravity perhaps midway between coal and slate, or even very nearly that of the clean coal, may go to the coal side of the apparatus ; but a preliminary crushing and sizing, reducing all pieces below a given maximum diameter (to be determined, doubtless, for each coal separately, but to be probably not more than ¼ inch diameter for any coal requiring washing) will separate all the pyrites from the coal or slate, leaving each to the action, in the process of washing, of its own specific gravity. Experimental illustration of this proposition is given below.

Again, a portion of the pyrites in coal as it comes from the mines seems to be in particles finer even than those of the coal dust, and constituting an impalpable powder. This "flour pyrites" floats in air or water. The following experiments were made to test its relative fineness :

A sample of finely crushed coal was passed over a 20-mesh screen. The material remaining on the screen contained, by analysis, 1.11 per cent., while that which passed through contained 1.49 per cent. of sulphur.

Again, a sample of coal dust was submitted to suction from a centrifugal blower. The part thus taken up and deposited in a separate chamber contained 1.36 per cent., while the remaining portion, not acted upon by the suction, contained 1.14 per cent. of sulphur.

These results, especially in view of the higher specific gravity of the pyrites, seem to prove conclusively that it pulverizes more finely than the coal.

The practical importance of this fact will be evident when it is considered that, in many plants where coal slack is washed for coking, the washed coal is passed over screens and the water is drained off, to be returned to the washing apparatus and used again. Obviously, this practice cannot give the best results ; for on the one hand some of the "flour pyrites" will be left on the coal in draining, and some will be carried back by the water, to accumulate by successive operations, and ultimately pass off with the coal.

With regard to both the foregoing suggestions, but chiefly as to the importance of the finer crushing of coal before washing, the following experiments may be of interest. They were made upon coal from the Pittsburg seam, and on a working scale, with samples of several tons. The apparatus employed was a trough washer, of a type in general use. Since the same apparatus was used in all the experiments, its special

merits may be regarded as not requiring attention in connection with this particular investigation.

A sample, A, of ordinary slack, with a sample, B, of the same slack, crushed to particles $\frac{3}{16}$ inch and less in diameter, were treated in the washer, and the cleaned material was analyzed. The analyses of the original slack and of the result from each sample, were as follows:

	Ash, Per Cent.	Sulphur, Per Cent.
Unwashed slack.....	10.51	2.876
A, washed.....	7.97	2.230
B, "	4.56	1.188

The result from sample B would make coke carrying about 1 per cent. of sulphur.

Another sample of Pittsburg coal, containing 11.95 per cent. of ash and 2.121 per cent. of sulphur, was crushed to about 20 mesh size, and washed as before, the result showing 4.86 per cent. of ash and 1.046 per cent. of sulphur. The coke made in a crucible from this sample contained 0.836 per cent. of sulphur—an amount well within the commercial limit.

In this experiment, the coal and water, after passing through the separator, were led into a settling bin, where the coal was deposited at the bottom, while the water (and with it the "float pyrites") was conducted away from the top in a stream half an inch deep. So much of the fine pyrites was carried on the surface of the water that the glistening particles should be readily skimmed off with the hand.

Additional experiments made with other coals have shown that the critical size at which an almost complete division of the coal and pyrites takes place varies with coals from different districts and beds. In designing plants for coal washing, the proper fineness of crushing should be determined beforehand by careful experiment.

As a result of the observations and experiments above described, I have been led to believe that, by due observance of the conditions indicated, coke of good quality could be made from many coals not now considered as suitable for that purpose, and many inferior cokes now in the market could be greatly improved.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

At the annual meeting of the Equitable Gas and Electric Company, Utica, N. Y., the following officers were chosen: Directors, A. N. Brady, Hugh J. Grant, Thos. E. Murray, H. W. Olcott, W. H. Bailey, Nicholas Brady, W. T. Baker, Chas. S. Symonds and H. J. Hemmens; President, A. N. Brady; Vice-President, H. J. Grant; Secretary, H. W. Olcott; Treasurer and General Manager, E. A. Pinkney.

The General Assembly of Connecticut will likely assent to the petition under which it is proposed to amalgamate the properties of the Citizens Gas Light Company, of Willimantic, and the Willimantic Electric Light Company. The title of the succeeding corporation is to be that of the Willimantic Gas and Electric Light Company.

The Berlin Iron Bridge Company, of East Berlin, Conn., is furnishing for the United States Government, at Port Caswell, N. C., a steel roof for the new torpedo storehouse at the place named. This storehouse is to be of fireproof construction throughout, and substantially built. The walls are to be of brick and the roof is to rest on steel trusses with purlins. The covering is to be of corrugated iron.

Report has it that the Racine (Wis.) Gas Light Company is again to be reorganized.

Mr. W. S. McCrea has been elected Treasurer of the Peoples Gas Light and Coke Company, of Chicago. Mr. L. A. Wiley, who has acted in the dual position of Treasurer and Secretary, retains the Secretaryship.

The Municipal Gas Company, of Albany, N. Y., has paid its regular quarterly dividend of 2½ per cent. The transfer books were reopened last Tuesday. The New Amsterdam Gas Company, of New York, has not yet paid a dividend, but Mr. Brady and Mr. Belmont still have hope that it will make some sort of a return some day. Mr. Brady is largely interested in the Albany Company.

The authorities of Manitowoc, Wis., are still considering the advisability of granting the right to operate a gas works there. The applicants for the right are said to be so numerous that it is proposed to ask them to bid for it, just as one would make a bid for a piece of goods at a sheriff's sale.

At the annual meeting of the Columbus (O.) Gas Company no change was made in the executive management.

"T. S.," writing under date of April 24th, says that the appointment of Mr. W. O. Beam to the office of Gas Inspector for Kansas City, Mo., has been confirmed.

The authorities of El Dorado, Kansas, are considering the matter of lighting the streets by means of the Welsbach burner.

The Federal Gas and Fuel Company projectors have asked the authorities of Cleveland, O., for the right to distribute natural gas for illuminating and fuel use in the city named. The petition was referred to the Board of Control.

A correspondent in Indianapolis, Ind., forwards the following: "Last month the Appellate Court rendered a decision, on appeal, in the case of the Indiana Natural and Illuminating Gas Company against the New Hampshire Fire Insurance Company. Judge Wiley, in reversing the opinion of the lower court, said that a Gas Company, in negligently allowing its gas pressure to increase during the night, to the point where such pressure would be liable to cause damage by fire in the instance of a burner turned low at slight pressure, would be liable for loss, unless it could be shown that the one damaged had in his possession a key whereby the pressure could be regulated at his will. It was shown that such a key was in the possession of the one whose property was injured (Patrick Slattery, of Crawfordsville), with the result that the Company which insured him against loss by fire had no cause for ultimate recovery against the Gas Company."

The executive management of the New London (Conn.) Gas and Electric Light Company, as named by its Board of Directors, is as follows: President, Robert Coit; Vice-President, George E. Terry; Treasurer, A. W. Young; Secretary and General Manager, F. L. Terry.

It is reported that C. D. Gibbons, of Cleveland, O., is the moving spirit in the application to the authorities of Youngstown, O., for an opposition gas franchise for the place named. Our informant adds that Mr. Gibbons and his friends have not one chance in one hundred to gain their point.

Mayor Kinney, of Utica, N. Y., has vetoed the resolution of the Board of Aldermen giving to the Herkimer County Light and Power Company the right to carry on business in Utica.

The Boston (Mass.) *Advertiser* says: "Attorney General Knowlton has given to the Legislature his opinion on a proposed act to compel the consolidation of the Boston Gas Companies. The questions were: '1. Whether the provisions of Section 11 of the proposed act for the consolidation of certain Gas Companies in the city of Boston, submitted in the 14th Annual Report of the Board of Gas and Electric Light Commissioners, are constitutional, and can be enforced in law or equity. 2. Whether a law requiring any two or more Gas Companies to consolidate without the consent of the Companies, can be enforced in law or equity.' The answers returned were: '1. If the proposed section be so amended as to contain an express provision that the charters of the Companies enumerated shall be repealed upon the contingency set forth, such a provision will be constitutional and could be enforced. 2. A law requiring two or more Gas Companies to consolidate without the consent of such Companies is not within the constitutional power of the Legislature; but a law providing that the charters of corporations shall be repealed unless they see fit to consolidate will be constitutional and can be enforced.'"

The Berlin Iron Bridge Company, of East Berlin, Conn., has been given the contract for furnishing and erecting the structural steel work, consisting of beams, girders, roof trusses and other material, for the New Britain (Conn.) Institute.

General Bird W. Spencer, Vice-President of the Paterson and Passaic Gas and Electric Company, whose particular part in the Company's affairs is the direction of its trading in Passaic, recently made the following announcement: "Beginning with the bills for the month of April, payable between the 1st and 10th of May, the price of gas will be reduced to $1.50 per 1,000 cubic feet net, in all cases, if paid within 10 days. If not paid within 10 days, the charge will be $1.60 per 1,000. The rate will apply to the new territory covered by Lodi, Garfield and other points, nothwithstanding the fact that the franchise in Garfield permits a charge of $1.75 per 1,000."

At the annual meeting of the Wilmington (N. C.) Gas Light Company, Colonel John W. Atkinson presided and Mr. A. S. Williams acted as temporary Secretary. The officers chosen were: Directors, John

F. Divine, Eugene S. Martin, Geo. W. Kidder, George R. French, E. P. Bailey, G. H. Smith and B. Solomon; President, E. S. Martin; Secretary and Treasurer, R. J. Jones; Superintendent, Jno. W. Reilly.

THE proprietors of the Bucyrus (O.) Gas Light and Fuel Company, have awarded a contract to the Western Gas Construction Company, of Fort Wayne, Ind., for the construction of a complete setting of the latter's improved Lowe, double superheater water gas apparatus. The Bucyrus Company will also extend its buildings, the roofs to the same to be of steel.

AT the annual meeting of the Sandusky (O.) Gas Light Company the officers elected were: Directors, C. W. Sadler, C. H. Moss, John Homegardner, A. C. Moss, John T. Mack, John Whitworth and G. W. Paine; President, Chas. W. Sadler; Secretary, C. H. Moss; Treasurer, A. C. Moss; Superintendent, Emil G. Schmidt.

MR. WILLIAM S. RISELAY has been elected Secretary of the combined gas interests of Buffalo, N. Y. His first connection with the gas business was with the Citizens Gas Company, of Buffalo, and on the absorption of the latter by the Buffalo City Gas Company he was appointed chief bookkeeper of the consolidated concern.

AT the annual meeting of the East Albany (N. Y.) Gas Light Company the following Directors were elected: William C. Smith, William Crane, Thomas Cochran, Jr., Jas. Purcell and Frederick A. Sabbaton. The Directors subsequently perfected the following executive organization: President, Jas. Purcell; Secretary, Thos. Cochran, Jr.; Treasurer, William Crane. This result goes to show that the Kinderhook Light and Power Company has acquired a controlling interest in the Gas Company.

A CORRESPONDENT in San Francisco forwards the following: "In the case of W. O. Booth against the San Mateo (Cal.) Gas Light Company, Judge Buck filed an opinion last month granting the relief prayed for by the complainant in his petition and $500 damages. The complaint was filed by Booth in August, 1898, and he is a resident of San Mateo. The defendant is a corporation having its principal place of business in San Mateo, and is engaged in manufacturing gas in the central and populous portion of the town. The gas plant was deemed a nuisance by the plaintiff on account of its close proximity to his residence, and he brought suit to have the nuisance abated, and for $5,000 damages claimed to have been sustained by him and his family. The complaint alleged that until within 60 days previous to the commencement of the action the defendant was engaged in its business in a portion of the town eight blocks distant from its present site and in a comparatively uninhabited locality. Sixty days prior to the filing of the suit the Company moved its works to the rear of and immediately adjoining the land and dwelling of the plaintiff. Sickening odors and gases have entered the Booth home to the detriment of its occupants' health. The plaintiff and his family were frequently nauseated and troubled with headache. Booth also attacked the manner in which the plant was conducted, alleging that it was a primitive and incomplete concern, and by reason of the fires kept in the furnaces, and by reason, also, of the defendant's carelessness, recklessness and negligence, dense black smoke arose from the smokestack and was driven in and upon his premises, filling his garden, yard and house, and soiling clothes hung out to dry. He further complained of the refuse water that was allowed to run from the works into his yard. The Company made a general denial of the matters complained of, and its defence in respect of showing that its plant was modern and well operated, was particularly strong. The case will be appealed to the Supreme Court."

THE following is from the Denver (Col.) *Post*, dated April 27th: "The Denver Gas and Electric Company has been incorporated with a capital stock of $3,500,000. Besides manufacturing and selling light, the Company is allowed by its papers to 'purchase, lease, acquire by consolidation or otherwise, own, manage and operate the properties and immunities of any gas or electric company or companies within the counties of Arapahoe and Jefferson.' The incorporators are Elroy N. Clark, Herman H. Dunham and Chas. W. Waterman. Its affairs are to be conducted by a Board of Directors, 13 in number, who are as follows: William S. Van Saun, Tobias B. Liverman, S. W. Cantrell, Frank H. Du Puy, Guy Young, Hobert C. Young, Angus W. Ward, William A. Burke, Elroy N. Clark, Herman H. Dunham, William W. Field, Chas. W. Waterson and George Treadway Thompson. C. W. Waterman, one of the incorporators of the Denver Gas and Electric Company, said this morning, in discussing the formation of the concern: 'No, there is no secret about it. The new Company will represent the consolidation of the gas and electric companies of Denver under one management. A meeting of the stockholders of both concerns has been called to act on the consolidation, and the latter will no doubt be approved without a hitch.' George T. Thompson, of the Denver Consolidated Gas Company, stated that the consolidation of the gas and electric interests would take place early in June. 'How about the new franchises?' Mr. Thompson was asked. He answered that that phase of the situation was being handled by the attorneys."

AN act to incorporate the Rhode Island Fuel, Coke and Gas Company is now before the Rhode Island House of Representatives. The purposes of the corporation as set forth are "the buying, making, generating, distributing, selling, leasing and using coal, coke and gas for heating, mechanical, motive and other purposes, and for manufacturing, using and dealing in all machinery, instruments, apparatus and appliances pertaining to the generation, distribution or use and installing of the same, with power to acquire such rights and franchises relating to the conducting of gas through or under the streets, highways and public places and elsewhere in the towns and cities in the counties of Providence and Kent." The place where said corporation is intended to be established is the city of Providence; and such right is to be exercised and such franchises are to be acquired in the towns and cities of Burrillville, Central Falls, Coventry, Cranston, Cumberland, East Providence, Foster, Gloucester, Johnston, Lincoln, North Providence, North Smithfield, Pawtucket, Providence, Scituate, Smithfield, Warwick and Woonsocket. The corporation will be capitalizsd in $1,000,000, and it will not interfere with any existing corporation unless it acquires same through purchase. The signers of the petition are: Frederic S. Pearson, Edward L. Freeman, George Batchelor and Charles G. Gray.

MR. W. H. BEAM has been appointed City Gas Inspector by the authorities of Kansas City, Mo. He succeeds Mr. L. F. McClum, who was a most capable man for the place.

THE American Voelker Company, to manufacture incandescent gas lamps, has been chartered in Delaware. It is capitalized in $20,000, with the right to increase the same to $1,000,000. Mr. Roswell P. Flower is said to be largely interested in the concern.

THE following is the text of a circular issued to the shareholders of the Washington (D. C.) Gas Light Company, respecting the terms for the purchase of their holdings:

"The undersigned committee, acting on behalf of such of the stockholders of the Washington Gas Light Company as may unite with them have entered into an agreement in relation to the sale of the shares of capital stock of the Company, on the terms following:

"The agreement is dated April 3, 1899, and has been deposited with the Fourth Street National Bank of Philadelphia.

"1. The price of the stock is $60 per share, which is to be paid in three equal installments, one-third on the 15th day of June, 1899, one-third on the 15th day of July, 1899, and one-third on the 15th day of August, 1899, with interest thereon at the rate of 5 per cent. per annum from April 1, 1899.

"2. The purchaser has deposited the sum of $250,000 with the Fourth Street National Bank of Philadelphia, out of which all expenses of the committee are to be paid, and no depositing stockholder will be subjected to any such expenses. In case the committee shall have secured the deposit of at least 87,000 shares of the capital stock on or before May 15, 1899, and the right of purchase shall not be exercised by the purchaser on or before June 1, 1899, the $250,000 deposited as aforesaid shall be paid over to and among the depositing stockholders *pro rata* as liquidated damages, less the amount required to pay counsel fees, costs and expenses incurred by the committee, and the agreement becomes null and void.

"3. If on or before May 15, 1899, stockholders holding 87,000 shares of the stock shall have deposited the same with the Fourth Street National Bank of Philadelphia, under the agreement and in the event that the purchaser elects so to proceed, he is required to take all shares additional to said 87,000 shares deposited before July 1, 1899.

"4. All dividends declared upon the stock of the depositing shareholders after April 1, 1899, shall be paid to the Fourth Street National Bank of Philadelphia, and will accrue to the purchaser, provided he completes his purchase, the 5 per cent. from the 1st of April, 1899, upon the purchase money being allowed to the shareholders in lieu of dividends. But if the purchaser fails for any reason to complete his pur-

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chase, then the dividends shall be paid over to the depositing stockholders according to their several proportions of stock so deposited, and at the same time the stock so deposited shall be returned to the depositing shareholders, respectively, without expense to them.

"5. The purchaser has the right, however, to buy on the same terms any less number than the 87,000 shares that may have been deposited on or before the 1st day of June, 1899, provided, however, that such less number shall be equal to a majority of the whole of the shares of the Gas Company, it being distinctly understood that the committee are not bound to sell their own stock, or that of any other stockholder, unless a majority of the whole of the stock shall be so deposited.

"6. The agreement also provides that in case the purchaser shall exercise the right of purchase, and shall fail to make the payment of one-third of the purchase money on the 15th days of June, July and August, respectively, as they become due, then the committee shall have the right to sell the stock and apply the proceeds to the payment of the $60 per share to the depositing stockholders according to the agreement.

"The committee believe that $60 per share is a fair price for the stock. They are willing to sell their own stock at that price, and have no hesitancy in recommending the sale to their coshareholders. They have thoroughly protected the rights of the shareholders by the agreement, and without unduly urging that others should unite in the sale, they do not hesitate to give it as their opinion that the price is a very fair and full one. No member of the committee is to receive any compensation of any kind in connection with this matter, and no one of the committee will sell his stock unless a majority of the stockholders shall unite in the sale.

"A copy of the agreement is deposited with John R. McLean, at the office of the Washington Gas Light Company, Washington, D. C.; with John C. Bullitt, Bullitt building, Philadelphia; and the agreement itself with the Fourth Street National Bank of Philadelphia, where access can be had to it by the stockholders, and full explanations made in regard to its provisions.

"Any stockholder residing in Washington or its vicinity can hand his stock to John R. McLean at the office of the Washington Gas Light Company, to be transmitted without expense to the stockholder to the Fourth Street National Bank of Philadelphia, and procure the temporary receipt which will be issued by the bank for the stock.

"Receipts will be issued by the Fourth Street National Bank to the stockholders for their stock when and as deposited, in a form which will make the receipts transferable and negotiable. It is desirable that the stock should be deposited by such stockholders as wish to dispose of it upon the terms indicated with as little delay as possible, and we would therefore ask, if you approve of the sale, that you will transmit or deliver your certificates of stock to the Fourth Street National Bank of Philadelphia as soon as convenient.

"You will find herewith form of assignment of your stock, which you will please execute and send with your stock to the Fourth Street National Bank of Philadelphia.

JOHN R. MCLEAN,
JOHN C. BULLITT,
JOS. G. ROSENGARTEN,
JOHN F. RODGERS,
JAMES W. ORME,
} Committee."

The Market for Gas Securities.

"Those whom the gods would destroy they first make mad," which rather free rendition of an ancient phrase seems to fit quite well the financiers who are anxious just now to secure control of the gas and electric lighting supply of New York borough. Having placated the Legislature, the successful conciliators immediately start in to pummel themselves. Reason and logic there may be for the "masterstrokes" of policy shown in the manipulation of New York city gas affairs last week, but the man outside the charmed circle may be pardoned for remarking that those within the band seem to have lost their heads. In any event those in the Consolidated who knew that the gas rate was to be put at 65 cents per 1,000 certainly had a golden opportunity. Of course, though, they did not take advantage of it. Meanwhile, within two months Consolidated has been as high as 223 and as low as 172. To-day (Friday) the closing was 181½ to 181¾. The cut to 50 cents per 1,000 by the New Amsterdam did not seem to unduly affect its shares, which were 35 to 36 for the common at the close to-day. Standard also suffered immaterially, while Mutual showed no change. It would be futile to speculate over the length of time the war will last. A sharp termination of the silly contest is quite in order. And our advice over the situation is that it is better to buy than to sell.

Brooklyn Union also broke sharply, the maximum decline in it being something like 10 points. Peoples, of Chicago, is strong, and Bay State is, as usual, weak. The general situation is clouded, mainly through the peculiar activity shown by promoters in asking for opposition franchises at almost every available place in the country.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

May 8.

☞ All communications will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$39,078,000	100	181⅛	181¾
Central Union, Bonds, 5's.	3,000,000	1,000	107½	108¼
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	315	325
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co.	13,000,000	100	35	36
Preferred	10,000,000	100	61⅛	62½
Bonds, 5's	11,000,000	1,000	100½	101
Northern Union, Bonds, 5's.	1,250,000	1,000	95	97
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	109	111
" 1st Con. 5's	1,500,000	..	112	114
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	120	130
Preferred	5,000,000	100	130	145
Bonds, 1st Mortgage, 5's	1,500,000	1,000	112	114
Yonkers	299,65	500	180	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	145½	146¼
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	3¼	3⅜
" Income Bonds	2,000,000	1,000	..	73
Binghamton Gas Works..	450,000	100	40	..
" 1st Mtg. 5's	450,000	1,000	95	98
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	92	..
2d " " "	3,000,000	1,000	68	71
Buffalo City Gas Co.	5,500,000	100	12	14
" " Bonds, 5's	5,250,000	1,000	89	91
Central, San Francisco	2,000,000	..	105	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,144,700	100	70	75
1st Mortgage	1,207,000	1,000	106	108
Consumers. Jersey City	2,000,000	100	88	..
" Bonds	600,000	1,000	102	105
Cincinnati G. & C. Co.	8,500,000	100	194	196
Consumers, Toronto	1,700,000	50	230	235
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	66	67
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	..
Consolidated Gas Co. of N.J.	1,000,000	100	23	25
" Con. Mtg. 5's	380,000	1,000	80	84
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,560,000	50	65	65½
" Prior Lien 5's	4,546,000	1,000	94¼	94½
Detroit Gas Co., 5's	423,000	1,000	95½	96
" Inc. 5's	31,000	100	..	..
quitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	62	65
" Bonds	2,000,000	..	80	85
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	145
Indianapolis	2,000,000	..	100	105
" Bonds, 6's	2 650,000	..	105	106
Jackson Gas Co	250,000	50	..	..
" 1st Mtg. 5's	250,000	1,000	..	..
Jersey City	750,000	20	225	275
Lafayette Gas Co., Ind.	1,000,000	100	68	70
Bonds	1,000,000	1,000	81	86
Louisville	2,570,000	50	106	108
Laclede, St. Louis	7,500,000	100	54	54½
Preferred	2,500,000	100	100	102
Bonds	10,000,000	1,000	107	108
Madison Gas & Elec. Co.	400,000	100	68	70
" 1st Mtg. 6's	350,000	1,000	102	..
Montreal, Canada	2,000,000	100	200	..

Newark, N. J., Gas Co	1,000,000	..	200	220
Bonds, 6's	4,000,000	..	128	130x
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co	1,000,000	50	110	..
Oakland, Cal	2,000,000	..	53½	55
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	127¼	127½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	111½	112
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	215	225
Rochester Gas & Elec. Co	2,150,000	50	52	..
Preferred	2,150,000	50	106	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal	10,000,000	100	74	75
St. Paul Gas Light Co	1,500,000	100	50	52
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	80	82
St. Joseph Gas Co	1,000,000	100	..	..
" 1st Mtg. 5's	750,000	1,000	.	..
Syracuse, N. Y.	1,750,000	100	16	19
Bonds	1,612 000	1,000	85	89
Washington, D. C	2,600,000	20	293½	293
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	97	97¾
Bonds, 5's	3,880,500	.	106	108
Wilmington, Del	550.000		208	..

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1233-tf Roanoke Gas and Water Co., Roanoke, Va.

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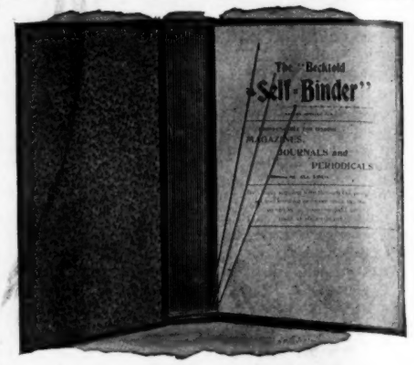

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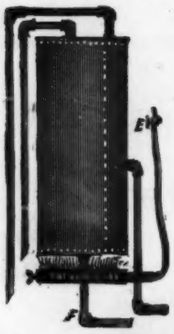

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BUFFALO CITY GAS CO., BUFFALO, N.Y., April 1, 1899.
J. P. B. SADTLER & CO., 813 S. Howard St., Baltimore, Md.
Gentlemen—Replying to your favor of the 30th of March. The Heller Heaters that you have already furnished seem to be large enough, and we will not at present care to use any of the larger size that you mention. We have had no complaint in regard to the Heller Heater that we have used in Buffalo, and so far they are giving us good satisfaction.
Yours very truly, E. H. JENKINS, Engineer.

BALTIMORE, MD., March 24, 1899.
J. P. B. SADTLER & CO., 813 S. Howard St., Baltimore, Md.
Gentlemen—A test of the Heller Water Heater witnessed by me March 21, 1899, showed that with a consumption of 30 feet of gas per hour, the water in a 28-gallon galvanized boiler could be heated from 59° to 102°, or 43° in one hour. Temperature of room at time of test 64°.
Respecfully,
GEO. BEADENKOPP, Ass't Engineer, Con. Gas Co.

Clamp Heater to Pipe about 4 Inches away from bottom of Boiler. Always use an independent connection, or regular Gas Stove connection, so as to get a good flow of Gas.

J. P. B. SADTLER & CO., 813 South Howard Street, Baltimore, Md.

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Colchester, Eng.	300,000
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Saltley Works, Birmingham, Eng. (2d Contract)	2,000,000
Windsor Street Works, Birmingham, Eng. (Second Contract),	2,000,000
Halifax, Eng.	1,000,000
Toronto,	250,000
Ottawa,	250,000
Toronto (Second Contract, Remodeled),	2,000,000
Lindsay (Remodeled),	125,000
Belleville,	250,000
Ottawa (Second Contract),	250,000

	Cubic Feet Daily.
Brantford (Remodeled)	200,000
St. Catherine's (Remodeled),	250,000
Kingston, Pa.	125,000
Montreal,	500,000
Peterborough, Ont.	250,000
Wilkesbarre, Pa.	750,000
St. Catherine's (Second Contract),	250,000
Buffalo, N. Y.	2,000,000
Winnipeg, Man.	500,000
Colchester, Eng. (Second Contract),	300,000
York, Eng.	750,000
Rochester, Eng.	500,000
Kingston, Ont.	300,000
Crystal Palace District, Eng.	2,000,000
Duluth, Minn.	300,000
Caterham, Eng.	150,000

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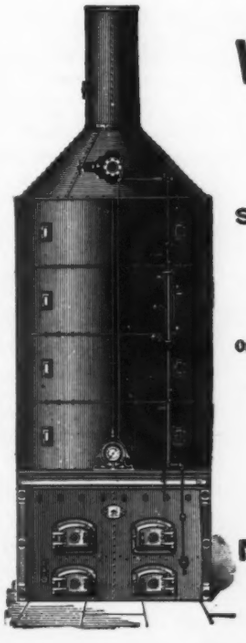

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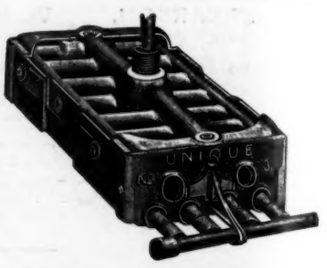

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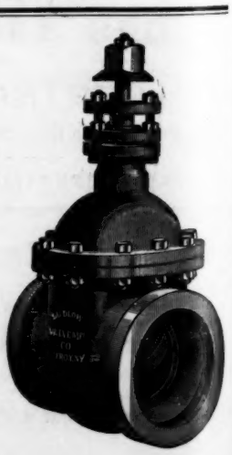

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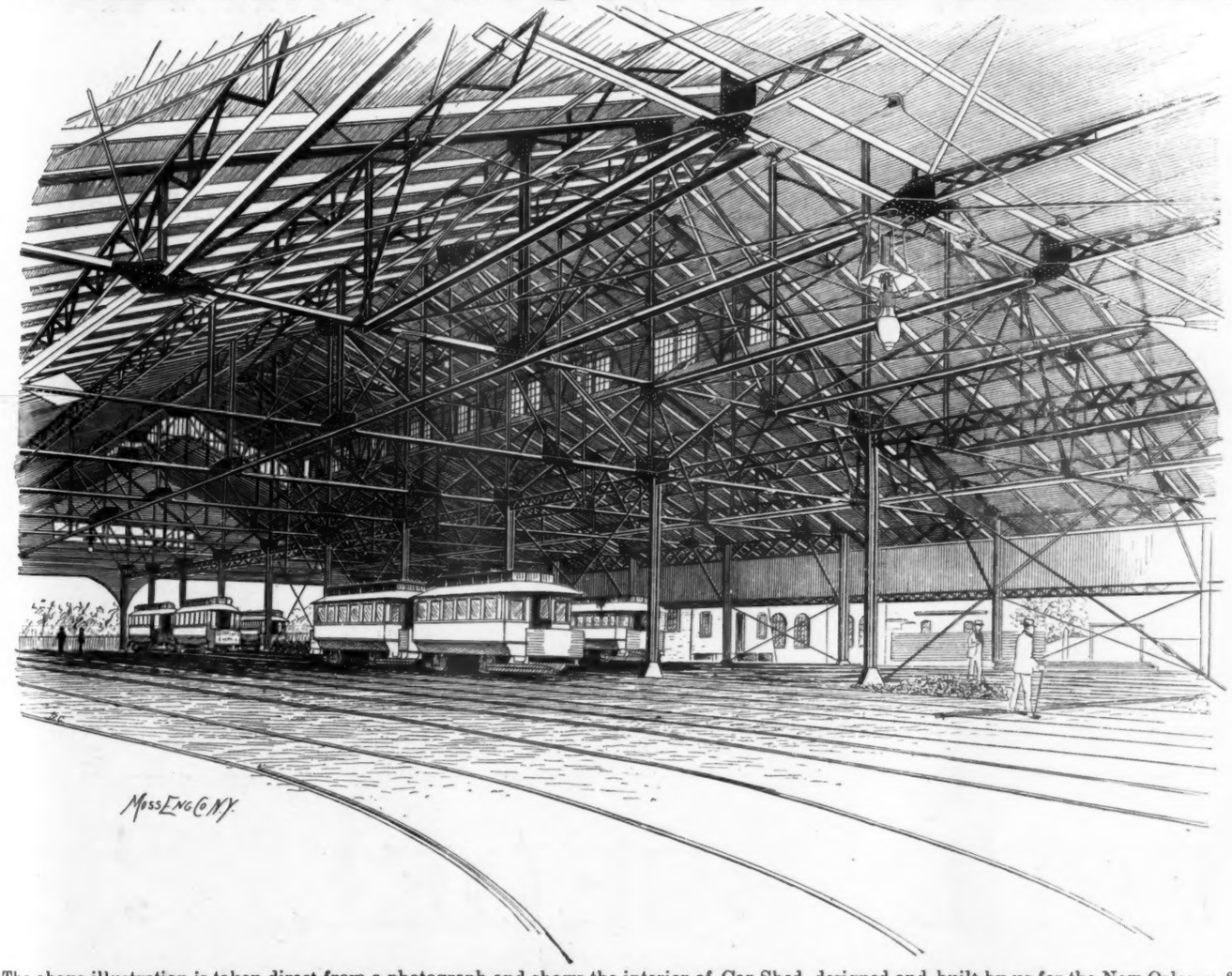

The above illustration is taken direct from a photograph and shows the interior of Car Shed, designed and built by us for the New Orleans & Carrollton R. R. Co., at New Orleans, La. The building is constructed entirely of steel and covered with corrugated steel. It is 130 feet wide and 300 feet long. The sides are left open for a distance of 10 feet from the surface of the ground, and the ends are left open entirely from the tie beam to the ground.

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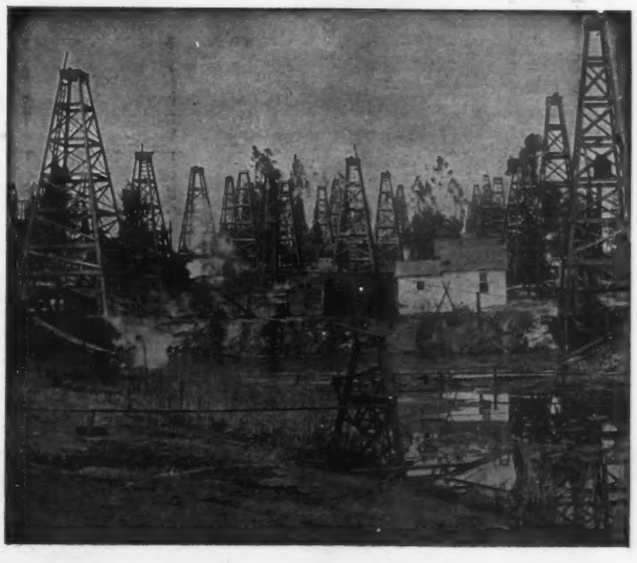

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MORE DIRECT IN ACTION. FEWER PARTS.
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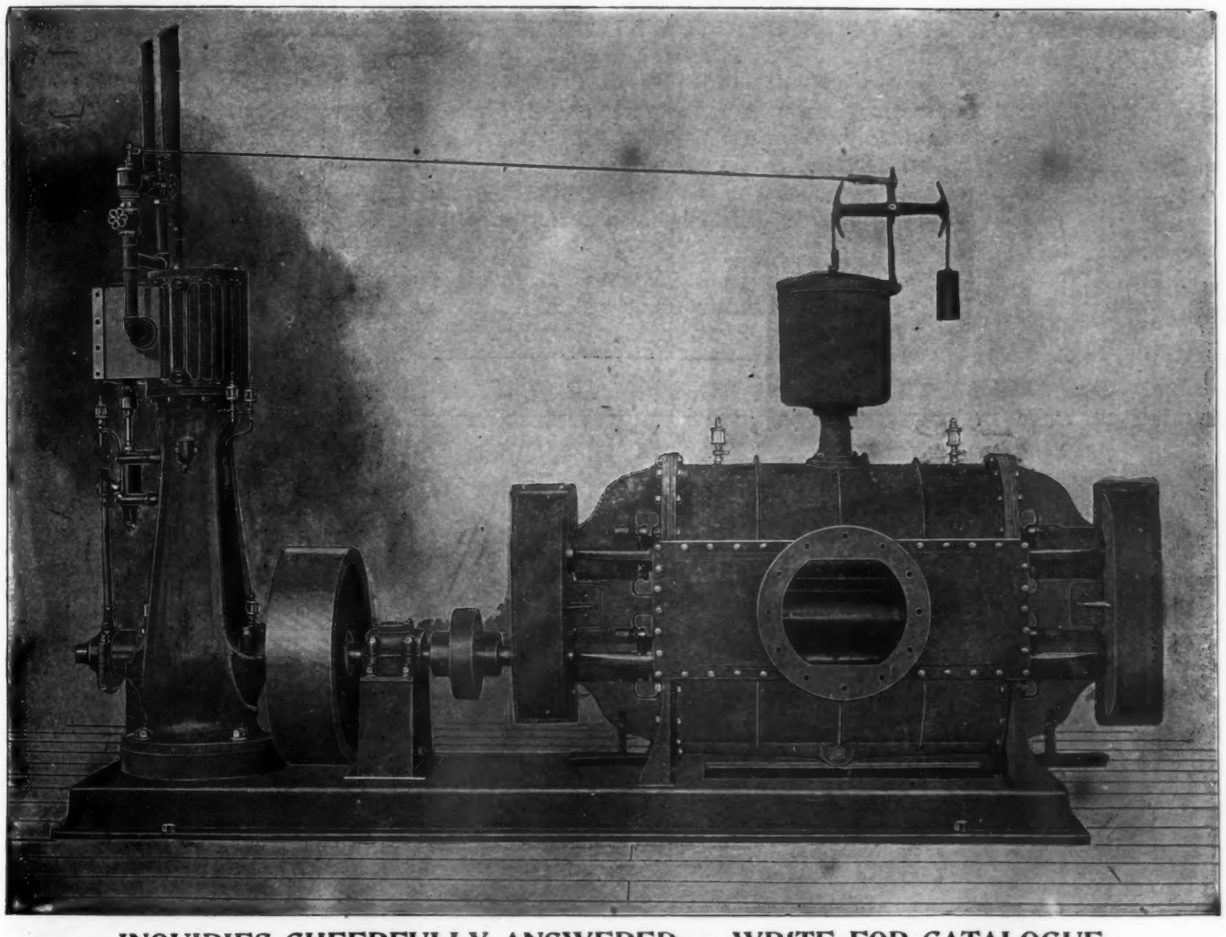

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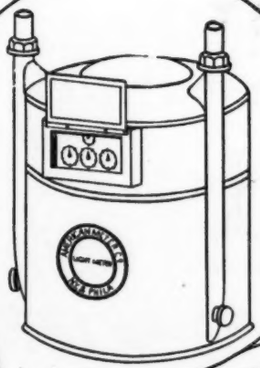

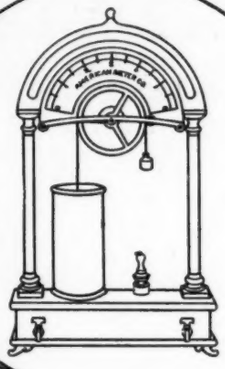

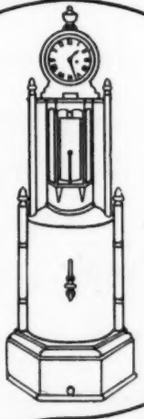

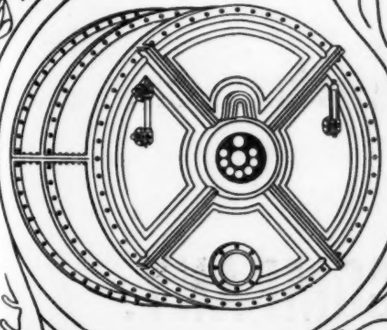

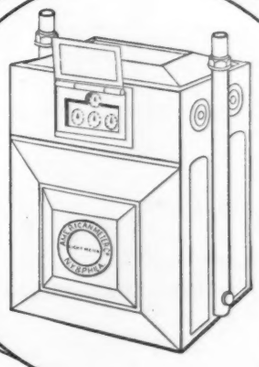

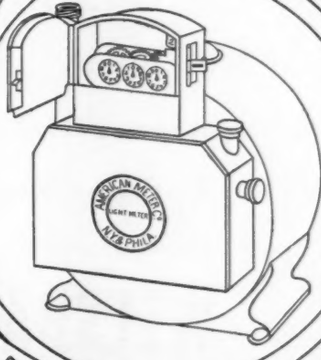

PUBLIC LIGHTING TABLE.

MAY, 1899.

Day of Week.	Table No. 1. FOLLOWING THE MOON.			Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING.	
	Date.	Light.	Extinguish.	Light.	Extinguish.
				P.M.	A.M.
Mon.	1	7.30 PM	1.40 AM	6.45	4.00
Tue.	2	7.30 LQ	2.20	6.45	4.00
Wed.	3	7.30	2.50	6.45	4.00
Thu.	4	7.30	3.20	6.45	4.00
Fri.	5	7.30	3.40	6.45	4.00
Sat.	6	7.30	3.50	6.45	4.00
Sun.	7	7.30	3.50	6.55	3.40
Mon.	8	7.30	3.50	6.55	3.40
Tue.	9	7.30 NM	3.50	6.55	3.40
Wed.	10	7.30	3.50	6.55	3.40
Thu.	11	7.30	3.50	6.55	3.40
Fri.	12	7.30	3.50	6.55	3.40
Sat.	13	7.30	3.50	6.55	3.40
Sun.	14	10.30	3.40	7.00	3.30
Mon.	15	11.00	3.40	7.00	3.30
Tue.	16	11.20	3.40	7.00	3.30
Wed.	17	11.50 FQ	3.40	7.00	3.30
Thu.	18	12.10 AM	3.40	7.00	3.30
Fri.	19	12.40	3.40	7.00	3.30
Sat.	20	1.10	3.40	7.00	3.30
Sun.	21	1.30	3.40	7.10	3.15
Mon.	22	2.10	3.40	7.10	3.15
Tue.	23	No L.	No L.	7.10	3.15
Wed.	24	No L. FM	No L.	7.10	3.15
Thu.	25	No L.	No L.	7.10	3.15
Fri.	26	7.50 PM	10.10 PM	7.10	3.15
Sat.	27	7.50	11.00	7.10	3.15
Sun.	28	7.50	11.40	7.15	3.15
Mon.	29	7.50	12.20 AM	7.15	3.15
Tue.	30	7.50	12.50	7.15	3.15
Wed.	31	7.50 LQ	1.20	7.15	3.15

TOTAL HOURS LIGHTING DURING 1899.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	215.40	January	423.20
February	184.40	February	355.25
March	187.40	March	355.35
April	166.50	April	298.50
May	158.00	May	264.50
June	140.50	June	234.25
July	150 30	July	243.45
August	168.30	August	280.25
September	179.50	September	321.15
October	213.20	October	374.30
November	217.00	November	401.40
December	238.10	December	433.45
Total, yr.	2221.00	Total, yr.	3987.45

Welsbach Patent Again Sustained.

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AMERICAN LIGHTING CO.
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HECKLA MANTLE WORKS, Henry Anhalzer, Prop'r.
MERIDEN-ALBERTA MANTLE CO.

All other manufacturers and sellers are cautioned against infringement on the Welsbach Patent and will be held liable for an accounting.

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THE STANDARD DOUBLE SUPERHEATER,

LOWE WATER GAS APPARATUS.

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	SETS.	DAILY CAPACITY.
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Derby, Conn.	1	750,000 "
Lowell, Mass.	1	1,000,000 "
Doylestown, Pa.	1	50,000 "
Darby, Pa.	1	400,000 "
Adrian, Mich.	1	125,000 "
Concord, N. H.	1	400,000 "
Sioux City, Iowa	1	750,000 "
Standard Gas Light Co., New York	3	5,400,000 "
Total	11	9,125,000 "
Previously built	294	187,100,000 "
Grand Total	305	196,225,000 "

Established 1858. Incorporated 1890.
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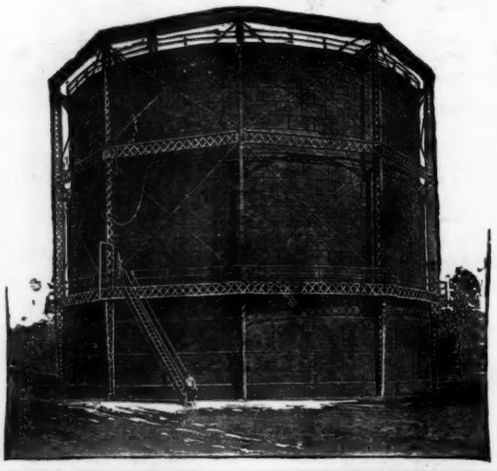

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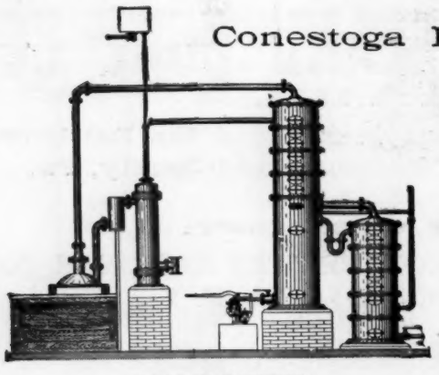

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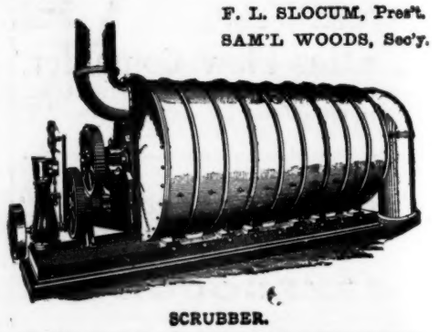

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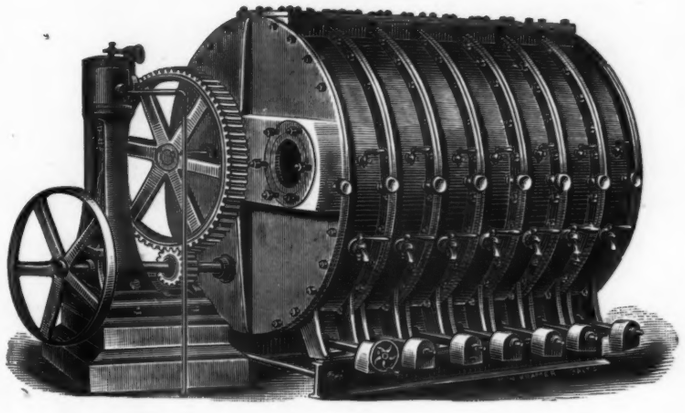

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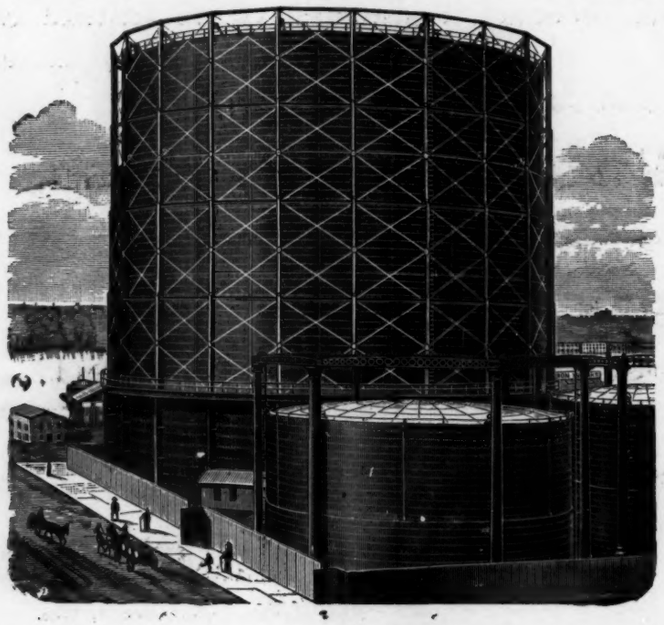

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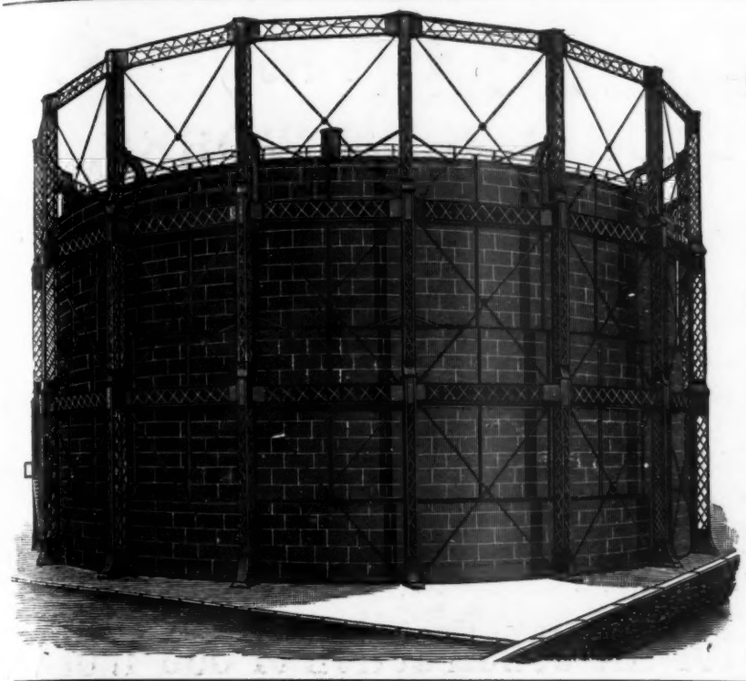

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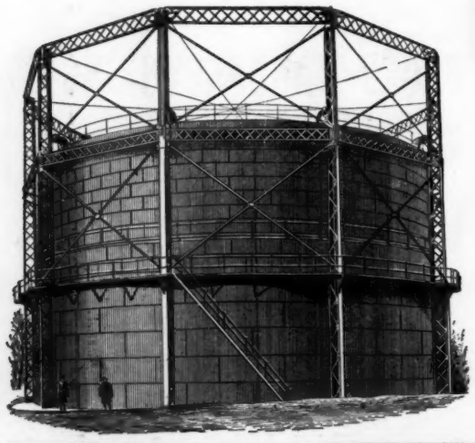

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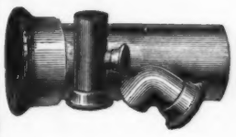

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The gas registered agrees absolutely with the amount purchased by the coin.

WE HAVE MADE AND SOLD IN THE UNITED STATES
OVER 30,000 OF THESE METERS,
ALL OF WHICH ARE GIVING PERFECT SATISFACTION.
Correspondence Solicited.
511 West Twenty-first Street, NEW YORK. | 51, 53 & 55 Lancaster Street, ALBANY, N. Y. | 34 & 36 West Monroe Street, CHICAGO.

NATHANIEL TUFTS METER CO.

ESTABLISHED 1849. No. 8 Medford Street, BOSTON, MASS.

Manfrs. of Consumers', Station, Test and Experimental Meters.

Sole New England Agents for the

PERFECT GAS RANGES.

In competitive tests it shows
the greatest
Efficiency, Durability, and
Saving in Repairs.

Made in four grades, with Price
and Size
to suit any condition.
We Guarantee every Range.

SEND FOR A SAMPLE AND MAKE YOUR OWN TESTS.

CHARLES E. DICKEY. JAMES B. SMALLWOOD. CHARLES H. DICKEY.

THE MARYLAND METER AND MANUFACTURING CO.

Established 1866.

BALTIMORE, North & Saratoga Sts. **CHICAGO, 107 West Monroe St.**
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CONSUMERS' & STATION METERS, PRESSURE GAUGES, Etc., Etc.

"Perfect" Gas Stoves

Now, doesn't it stand to reason that

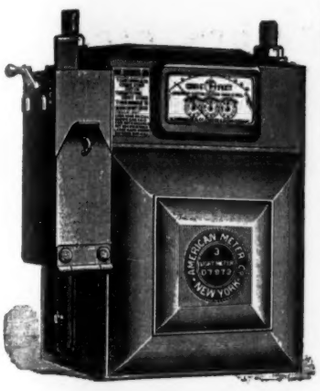
OUR METERS MUST BE ALL RIGHT,

else how could we

STICK TO BUSINESS AND KEEP A-YELLIN'

all these years?

THE KEYSTONE METER CO.,
Royersford, Pa.



American Meter Co.

NEW YORK, PHILADELPHIA,
SAN FRANCISCO.

Prepayment Meters.

Their construction is such that they may be readily readjusted when the scale of gas rates is changed.

HELME & McILHENNY,

Established 1848. **1339 to 1349 Cherry Street, Philadelphia, Pa.**

MANUFACTURERS OF

Wet and Dry Gas Meters, Station Meters, Provers, Gauges, Etc.

METERS REPAIRED

PREPAYMENT GAS METERS.

Our Own Patents. Strong. Simple. PROMPT ATTENTION. CORRESPONDENCE SOLICITED.

METRIC METAL COMPANY,

MAKERS OF

GAS METERS for NATURAL and ARTIFICIAL GAS.

Special Attention given to Repairing METERS of all Makes.

FACTORY AT ERIE, PA.

This is the best time to look after your repairing.

Seventy per cent. of old meters run slow. You are losing money on them. Let us put them in shape for you, a few at a time, until your entire meter equipment is made as good as new. It is better to attend to this matter now, before the Gas Stove season is at its height. Probably we can do such work in our factory better and cheaper than you can do it at home, and just now we can do it promptly.

The BUHL METERS are as good Meters as you can get.

DETROIT METER COMPANY, - - Detroit, Mich.

The Advertisement of

JOHN J. GRIFFIN & CO., Mfrs. of Gas Meters, etc.,

Nos. 1513, 1515, 1517, 1519 & 1521 Race Street, Philadelphia,

52 Dey Street, New York, 75 N. Clinton Street, Chicago,

Occupies this space every alternate week.

In 1898

23 Sets Improved Lowe Water Gas Apparatus of from 75,000 to 1,500,000 Daily Capacity, and 2,500,000 Cubic Feet Daily Capacity Coal Gas Bench Work.

THE

WESTERN GAS CONSTRUCTION COMPANY,

Engineers and Builders,

FORT WAYNE, IND.

Improved Lowe Water Gas Apparatus.
General Gas Works Construction.
Coal Gas Apparatus.
Special Apparatus.
Special Fittings.
Gas Valves.

WILLIAM HENRY WHITE,
EASTERN ENGINEER,
32 Pine St., New York.

GAS VALVES
that can be TAKEN APART AND CLEANED WHILE IN USE.

Our Specialty
is the design and arrangement of apparatus to meet special Local Conditions for utilization of the most advantageously procurable materials and convenient operation.